PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 146 Franklin Street, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION, IN ADVANCE. ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

IN CLUBS of four or more, $2.50 a year each; with a free extra copy to the getter up of a club of 8. Foreign subscription, $5 a year.

In requesting your address changed, give **old** *as well as new address.*

ESTABLISHED 16 YEARS AGO, **THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America and has well maintained its lead. It has a LARGER CIRCULATION than any other electrical periodical in the world, and is the BEST ADVERTISING MEDIUM.**

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

For Sale Notices, Situations or Help Wanted, $1 to $2 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Address all communications to

THE W. J. JOHNSTON COMPANY, Ltd.,
Times Building, New York
OR ANY OF THE BRANCH OFFICES.

VOL. XVI. NEW YORK, AUG. 16, 1890. No. 7.

CONTENTS.

EDITORIAL: PAGE.
Paragraphs ... 97
ILLUSTRATED ARTICLES:
New Van de Poele Motors ... 98
The Kemmler Execution ... 99, 105
Tesla Alternating Motors ... 101
Switch for Electric Light Fixtures ... 102
The Tesla Transformer ... 102
Bain's Lightning Arrester ... 102
Flood's Car Starter ... 102
Efficiency Tests of Electric Railway ... 103
Electrical Distribution by Tranformers ... 104
Conical Lamp Shade ... 106
Switch for 3,000 Ampères ... 106
Friction Cone Plant ... 106
Maxwell Current Protector ... 106
Switch for Incandescent Circuits ... 106
Death of J. H. Wade ... 107
Working Efficiency of Secondary Cells ... 107
MISCELLANEOUS:
New Books ... 98
The Minneapolis Exhibition ... 98
Prominent Southern Power Station ... 104
Amenities of African Telegraphy ... 106
Important Changes in the Edison Company ... 107
SPECIAL CORRESPONDENCE:
New York Notes ... 108
New England Notes ... 109
Philadelphia Notes ... 109
Western Notes ... 109
Southern Notes ... 110
English Notes ... 110
NEWS OF THE WEEK:
The Telegraph ... 110
The Telephone ... 110
The Electric Light ... 110
Applications of Power ... 111
Miscellaneous ... 111
Personal ... 111
INDUSTRIAL AND TRADE NOTES ... 111
ANSWERS TO CORRESPONDENTS ... 111
BUSINESS NOTICES ... 111
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 112

A Promising Outlook.

EVERY indication seems to point to a very pleasant and profitable summer meeting of the National Electric Light Association. Day by day come assurances that a strong delegation of the electrical fraternity will gather at Cape May, and the programme already published is a sufficient guarantee that the papers will be well worth hearing. It is possible for the Association committees to do capital work in investigation, and with the growing influence of the body they represent comes the assurance that the reports made will carry great weight. Each year has shown the increasing importance of this feature of the great semi-annual consultation of electricians, and much good has already been done. We hope that every member of the Association will make an earnest effort to run away from his business cares for a few days next week and take an active part in the proceedings. The more the merrier, and the more useful to all.

Another Alternating Motor.

THE construction of motors for alternating currents has advanced along several distinct lines. The difficulties to be met are great and the means taken to overcome them have been very various. The type of machine to which Mr. Van Depoele's recent invention belongs is peculiarly a modern development, since it does not follow at all the alternating dynamo as its model, but utilizes the effect of an alternating field on the currents generated by it in a closed-circuit armature. In the absence of experimental facts it is difficult to say much of the advantages of this arrangement. It has the merit of simplicity, but just how far efficiency can be secured can only be told by trial. The faults of alternating motors are, in general, inability to start under load, severe hysteresis, and sparking at the commutator, if there is one. As a rule it has been the fate of inventors, in avoiding one of these evils to fall upon another. Mr. Van Depoele's venture possesses some obvious good points, and we trust that future experience will show that he has been more fortunate than his numerous predecessors.

Friends and Allies.

SIMULTANEOUSLY with the Cape May meeting of the National Electric Light Association occurs another meeting in Indianapolis that should be regarded by electricians with friendly interest. Although the American Association for the Advancement of Science is by no means a body devoted to discussing the applications of electricity yet it does good service, both directly and indirectly, to electrical science. It awakens and sustains a lively interest in scientific progress in a large class that can do much to advance the cause of practical knowledge of every kind, and besides this it is seldom that a meeting does not bring forth papers treating directly electrical problems, some of them abstruse perhaps, yet all of them adding to the future resources of the practical engineer. Electricians have good cause to recollect the Philadelphia meeting of 1884, for it was made memorable by Rowland's discussion of the magnetic circuit, that was the direct cause of great and immediate improvements in dynamo designing. It is not always to the practical man that we must look for practical suggestions, and considering the past it is well to keep a watchful eye on the proceedings at the western meeting of our theoretical brethren.

A Great Central Station.

THE description of the immense alternating current central station in Rome, given this week in Dr. Fleming's paper, is specially interesting reading for an American. We have as yet in this country done very little in the way of colossal alternating machines. Even a hundred kilowatts is beyond the limit of our practice and machines as large as those in Rome are quite unknown. The early experiences with dynamos of great capacity in England has done much to discourage experiments, and it is only recently that much progress has been made. But here in a foreign land we have direct coupled alternators of five hundred horse power, driven by compound engines, and the combination is reported to work smoothly and economically. In theory, size should be rather an advantage in a dynamo, but as it increases, the details of construction must be somewhat changed, and as experience teaches the necessary modifications there is every reason to believe that very large machines will become far more common than at present. Still it must be borne in mind that individual dynamo capacity as a function of normal station load has an important bearing on economy, and that it is quite possible to go too far in the direction of larger units.

A Serious Question.

THE execution of Kemmler seems to arouse the opponents of capital punishment to renewed activity, and it is more than hinted that the present law may be repealed in the near future. Concerning the advisability of abolishing the death penalty it is not our purpose to speak, but the effect of using the ghastly details of the recent example to excite public abhorrence is strongly to be deprecated. It could only result in an increase of the popular fear that has hindered electrical progress before now. Nothing is to be gained by clamoring over horrors that are not altogether genuine, and twisting and distorting the facts to suit the demands of sentimental enthusiasm. There was no very good reason for a change in the method of execution in the first place, and the whole history of the present law has been unhappy in its effect on electrical interests. The less disturbance about the matter the better, and we trust that if it is thought best to repeal the present law unconditionally, or to return to the former one, it may be done calmly and deliberately, without fervid imaginings or wild appeals to the feelings. It was bad enough to establish the electrical execution law, but unwise agitation for its repeal may do more harm than its continuance.

The Electrical Execution.

THE task of detailing the unpleasant story of the application of the foremost agent of modern progress to judicial homicide is a painful one. It is due to our readers, however, to give the plain, uncolored facts in the case so far as they are now known, without indulging in horrible minutiæ, or, on the other hand, omitting or concealing anything of the truth. Through Mr. Huntley, an eye-witness of the execution, we are enabled from the standpoint of the electrician to tell what actually occurred. In his clear and thoughtful description we may confide, as a straightforward account of the first electrical execution. To the description of the apparatus, carefully illustrated on another page, we have added the critical opinions of well-known electrical and medical experts which throw light on the case, particularly as regards the general effect of the deadly experiment. The result, from whatever point we view it, must be regarded as unfortunate. That the first shock produced instantaneous and complete insensibility there can be no reasonable doubt; but at what instant that unconsciousness merged into final dissolution no human being can ever know. It may have been almost simultaneous with the first rush of current, or at any time within the few succeeding minutes. Probably death would have been immediate had there been more expert care in the preparations. An uncertain foundation and a slipping belt make it highly probable that the voltage to which the victim was exposed was considerably below the intended amount. Mr. Edison's critique of the whole subject seems to us a remarkably fair one, except that he apparently supposed that the bank of lamps might have been in series with the chair, while it was designed to be a shunt across the mains, which lessens the force of his comment. In the light of Dr. Tatum's researches it seems highly probable that the choice of position of electrodes was unfortunate, for not only were the contacts somewhat ineffectual, as Mr. Edison suggests, but the heart was comparatively removed from the direct action of the current. It is most unfortunate that accurate measurements of current and voltage were not made as was originally intended, for as it is the result is completely without scientific value. Much allowance must be made for the published reports of the execution, as many of the spectators were unstrung by the strange scene; but it is certain that, while electrical execution is physically humane, because painless, it is open to very grave objections, which the first experiment has made only too manifest.

Electric Railway Efficiency.

MR. HULETT'S test of an electric street railway system throws some new light on the complex conditions of general efficiency. In the first place it relates to a type of motor that, although it is very largely used, has, until now, been quite unrepresented by any careful study of its properties. Previous work has been confined almost exclusively to Sprague roads. The Thomson-Houston motor, exhibiting as it does a totally different method of regulation, might at first sight be expected to show an efficiency equally distinct. The result proves, however, that so far from this being the case, there is no wide difference between the results obtained from the respective systems either in motor efficiency at the given speed, total efficiency from engine to car wheel, or power required per car mile. It is rather a pity, however, that Mr. Hulett's field of operations was so favorable, for had the grades and curves been more severe, a still more interesting comparison might have been obtained. The use of a self-registering ammeter is a most valuable innovation in the study of the problem in hand, and the erratic zigzag curves which we reproduce from the tracings of the instrument show more clearly than any words the enormous variations in load that render economy so difficult of attainment. The details of the test show clearly the advantage to be derived from the use of the high-speed engine of moderate size instead of the larger slow-running machine. To face this question intelligently we must remember that when each is working at its full normal output, the latter type has rather the advantage in economy. But in the kind of service we are considering an engine is seldom or never worked at the most economical point of cut-off. Just here lies the advantage of the newer form of engine, for inasmuch as the cut-off may be as late as six-tenths or three-quarters stroke, a comparatively small cylinder can be used, worked as occasion requires on both sides of its point of maximum economy. Since the waste of steam involved in overloading is less than that in underloading and from the greater range of cut-off an engine can be selected so that its average load shall be somewhere nearly its most economical one, the disadvantage of a somewhat less perfect valve gear is more than offset. This is especially true in small systems like the one under discussion, while as the number of cars is increased the load is somewhat steadied, so that the differences may quite disappear. It should not be forgotten that in making the comparison of engines we are considering in each case machines of proper size for the work. The often quoted figures from the La Fayette, Indiana, road represent a case of gross underloading and should not be taken as an average performance. The total commercial efficiency found by Mr. Hulett is certainly a good average performance, and the coal consumption, while it was unfortunately somewhat inexact, is not excessive, although showing the effect of light load. The performance of the motors was unfortunately not examined in great detail, but considering the speed the estimate is not at all unsatisfactory. It is now quite clear that these figures are not likely to be much surpassed, so long as the present gearing is adhered to. A pair of motors each twice geared is most unsatisfactory from a mechanical point of view, and must eventually be replaced. A single motor once geared, or directly upon the axle, would bring the motor factor of the efficiency to a much more agreeable point. But with all this we must notice that the actual saving in cost of fuel that can be made by any increase in efficiency that may be expected is not very large, and that the great gain in the various improvements will be the simplification of the running gear, and with this greater reliability and lessened cost of repairs.

NEW BOOKS.

Das Elektrische Licht. By Dr. A. R. von Urbanitzky. Electrotechnical Library, Vol. III., 3d edition; 272 pp. 119 illustrations.

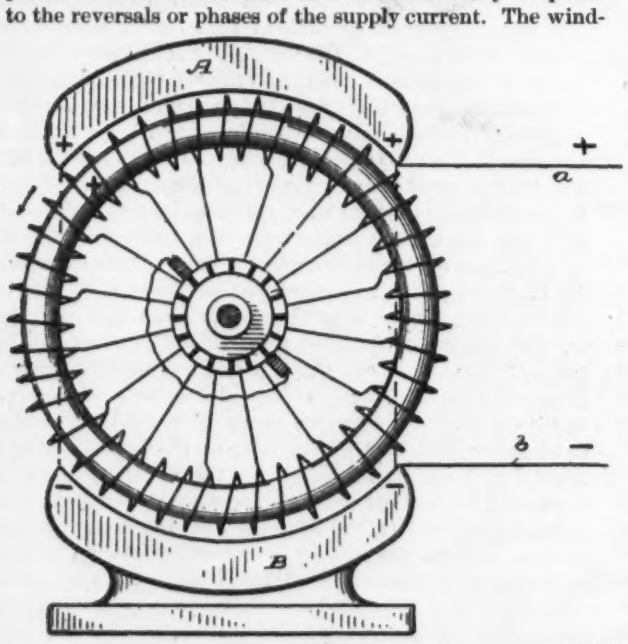
The volumes of the Electrotechnical Library have already become well known as good popular expositions of the fundamental facts of applied electricity. The present little book gives in simple form and with more accuracy than is usually found in works of its class the main facts and principles of the electric light as we know it to-day. Both arc and incandescent systems are taken up and a very large number of typical forms of lamp are given in considerable detail. The illustrations are numerous and clear, and add much to the effectiveness of the descriptions. Little attempt is made to go into the scientific details of lighting, but throughout the accounts of the various forms of apparatus used are admirably clear. Considerable additions have been made in publishing this third edition, and the book has been brought well up to date. It is enriched by copious references to original publications, and contains a very available index.

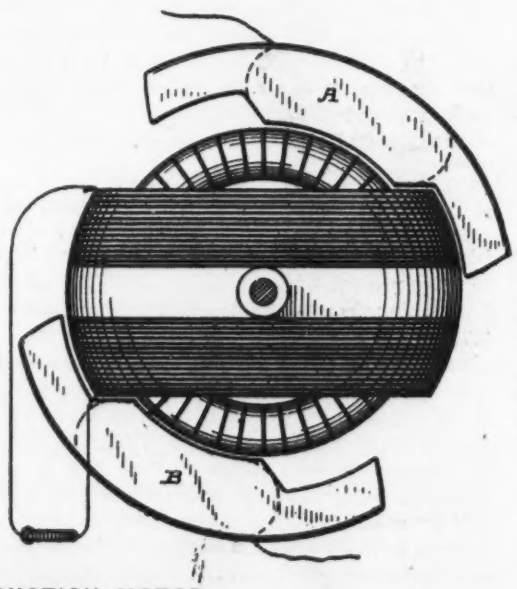
New Van Depoele Induction Motor.

Owing to the very extended use of the alternating current for electric lighting, the subject of the electric motors intended for operation on this class of circuits has a very important commercial bearing. For this reason the accompanying description and diagrams of the new induction motor of Mr. Charles J. Van Depoele will be of great interest. While it is in some respects a development of some of Mr. Van Depoele's previous work* along much the same line with direct current machinery, yet it possesses many novel and interesting as well as valuable features. It is intended for operation by currents of alternating polarity, or by currents having a definite rise and fall, whether of alternating or of constant polarity.

In the motor here described the field magnet coils are supplied either with an alternating or intermittent current, the cores being suitably laminated to secure the desired rapidity of magnetization and demagnetization. The magnetic field thus produced acts inductively upon the closed-circuited winding of the armature, which is here shown of the Gramme type. The brushes of the machine are connected, through a resistance if necessary, to afford a definite path for the secondary current generated in the armature coils. Mr. Van Depoele has found that the effect upon the core of the armature may be increased by additional windings connected in separate closed sections, not connected to the commutator, in which also induced secondary currents are produced.

The simplest form of this type of motor is shown in Fig. 1. The pole pieces are shown at *A* and *B*, the magnetic circuit being completed through the Gramme ring armature and suitably laminated field magnet cores. The pole pieces are also subdivided so as to secure a ready response to the reversals or phases of the supply current. The winding of the armature is connected at suitable intervals with the commutator sections. The brushes are electrically connected by a conductor as shown in Fig. 1, so that currents induced in the armature coils will flow in the paths defined by the position of the brushes, and will produce opposite polarities in the armature core on a line passing through the centre of the brushes. It is evident then that the position of the armature poles and the direction of rotation of the armature can be controlled by the adjustment of the brushes. If a resistance-box or other current controlling device be placed in the armature circuit between the brushes, the flow of current in the armature may be regulated as desired.





FIGS. 1 AND 3.—VAN DEPOELE INDUCTION MOTOR.

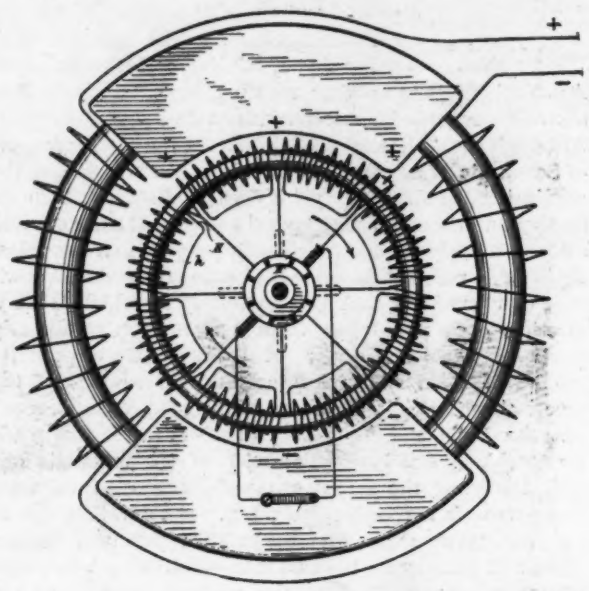
The machine shown diagrammatically in Fig. 2 differs from that just described in having two separate sets of windings upon its core. The coils are connected to the sections of the commutator as in the machine shown in Fig. 1, but an additional set of coils *H* are provided to form a number of independent closed circuits upon the armature core. Both sets of coils, being energized by secondary currents produced in them under the influence of the reversals of polarity in the field magnets, will have generated in themselves currents of similar name, and will act in harmony to establish poles in the armature core.

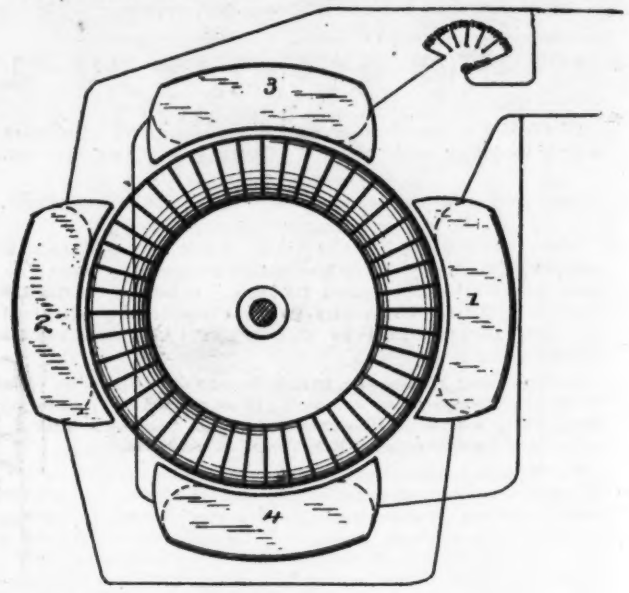
In Fig. 3 is shown a modified form in which the armature is provided only with uncommutated coils, which are formed into a number of closed circuits upon the armature and adapted, when acted upon inductively, to magnetize the iron core by which they are carried, so as to form poles which being reacted upon by the field-magnets will cause the armature to rotate upon its axis.

Where the armature is provided only with uncommutated coils, as in Fig. 3, means other than a commutator and brushes must be provided for establishing and defining the polar line. For this purpose the armature is provided with an exterior coil or coils, as shown in Fig. 3, portions of which pass under the undercut ends of the polar extensions of the field-magnets, and when arranged in this manner, so as to be in inductive relation to the field-magnet poles, the induction coil will become the seat of induced currents in secondary relation to the field-magnets, and these secondary currents flowing in the induction coil will create tertiary currents in the closed circuits upon the armature core. The induction coil, being arranged in close relation to the armature and enveloping a large portion of it, will therefore create a polar-line in the armature, which will be substantially upon the transverse axis of the induction coil, and this, in the position shown, will place the poles in the armature in the most desirable position to be acted upon by the poles of the field magnets. As indicated, each half of the ends of the coils of the induction coil fit under and are in inductive relation to the undercut extremities of the polar extensions of opposite polarity. This will cause a flow of currents in the induction coil. The opposite ends of each of the polar extensions are similarly undercut, and the induction coil being movably sustained may be reversed in position, so that opposite portions will come into inductive relation to opposite poles of the field magnet. This will change the direction of the flow of secondary currents in the induction coil, and correspondingly the polarity or direction of flow of the tertiary currents in the armature, thereby reversing the direction of its rotation.

In Fig. 4 is shown another modification in which the same result is produced, without the use of an induction coil, in a machine having only closed-circuited armature coils. The magnetizing coils of the four polar extensions shown in Fig. 4 are each energized by a magnetizing coil, these coils being supplied alternately or in pairs with current phases. These phases may be supplied from two separate circuits, or the two sets of magnetizing coils may be connected in derivation and the phases in one circuit be retarded by a reactive coil, or the mass of the cores of one pair of magnets may be heavier and more sluggish than that of the other pair, or the desired lag may be provided for by making the resistance of one field-magnet circuit greater than that of the other, the object being to magnetize and demagnetize the pole pieces in alternation.

The polar extensions inclose a large proportion of the exterior of the periphery of the armature, and will therefore serve to create secondary currents in most, if not all, of the separate closed circuits upon the armature core. Assuming that the poles, 1 and 2, Fig. 4, have just been magnetized to their highest point, they will attract any poles existing in the core of the armature and at the same time will create secondary currents flowing in the adjacent coils. These currents will produce new poles in proximity to the opposite set, 3 and 4, of the field magnet extensions, since the magnetism, created in the core of the armature by the secondary currents produced in the coils adjacent to the active field magnet poles, will not be at once dissipated, and will, in fact, be retained for an appreciable moment of time, the duration of the magnetic lag depending upon the thickness of the iron portions comprising the magnetic circuit of the armature. The poles established by the preceding secondary currents having therefore some sort of stability, the poles set up in the diametrically opposite set of field magnet extensions will attract them and exert a powerful torque upon the armature. It will thus be seen that by continually shifting the energizing current, or directing an energizing current to the two pairs of polar extensions, the magnetism created in the armature core by the secondary currents will establish poles which will be strongly attracted and cause the armature to move toward the succeeding field magnet poles created in a different set of pole pieces.





FIGS. 2 AND 4.—VAN DEPOELE INDUCTION MOTOR.

Many other modifications of this type of motor are suggested by Mr. Van Depoele differing only in detail from those here shown and described, the general principle of operation being the same in each case, whether the armature of the machine be a Siemens or a Gramme, or whether the number of the poles be two, four or any other convenient number.

The Electrical Exhibition at Minneapolis.

The general manager of the exposition at Minneapolis, Mr. William M. Regan, kindly furnishes us some details of the plans thus far matured as to the arrangements of the different exhibitors. Mr. Regan believes that this will be the most complete electrical display ever made, including as it will not only the Edison plant from Paris, recently shown in New York at the Lenox Lyceum, but also a very full display by the Thomson-Houston interests, and especially the latest developments in electric welding.

The principal feature of the Edison exhibit, as we stated in our issue of June 28, will be a tower of glory about 70 feet in height and 8 feet in diameter at the middle. This tower has now been built, and is of Egyptian design, and bears no less than 7,500 incandescent lamps. From its apex will hang festoons of lamps in various designs, making it, as Mr. Regan very justly remarks, "the most brilliant lighting spectacle in the world."

The Edison exhibits will be in charge of experts from the Menlo Park laboratory, who will give practical lessons to the sightseers of the workings of the wonderful talking dolls, the railroad, and the various telephone patents, telegraph instruments and phonographs. The Thomson welding apparatus will also be seen in actual operation, and will attract very great interest from both experts and laymen.

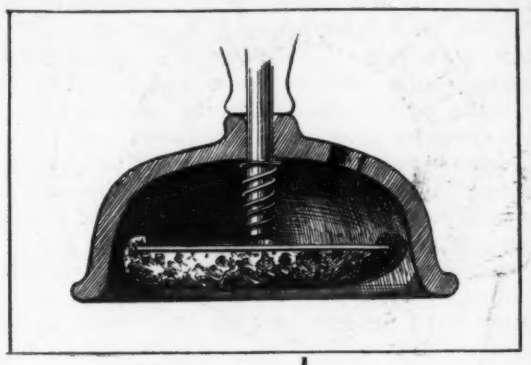
In addition to these exhibits many other firms will have displays, among which that of the Carpenter Nevens Electric Heating Company will, no doubt, be amusing to visitors, as it will show them such electric feats as ironing, laundering, frying doughnuts, and so forth, as well as their new method of electrical soldering illustrated in our patent record this week.

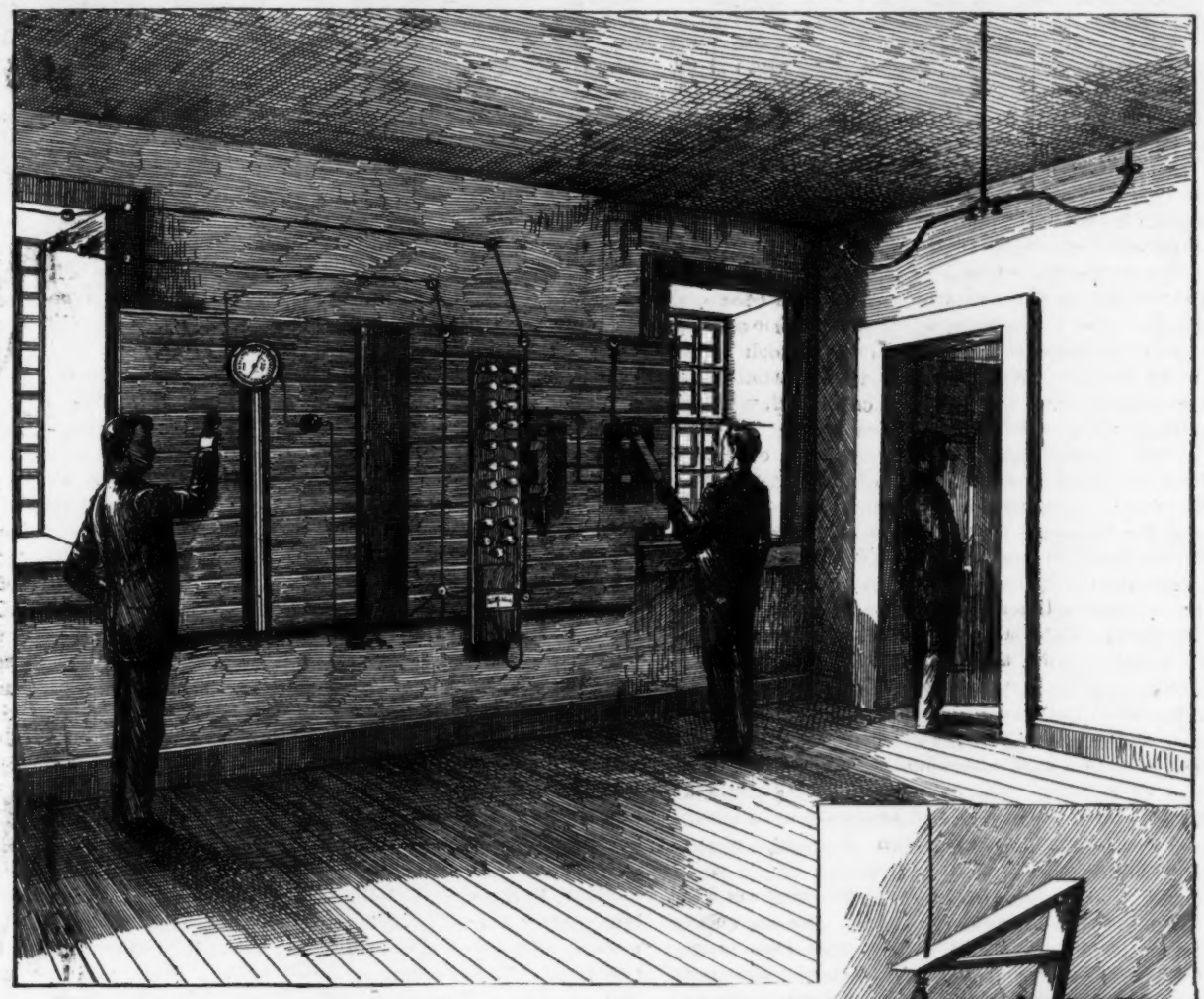
Mr. Luther Stieringer was in Minneapolis last week, voluntarily assisting in the preparation of the Edision exhibits, which are being put in place under the supervision of Mr. E. W. Hammer.

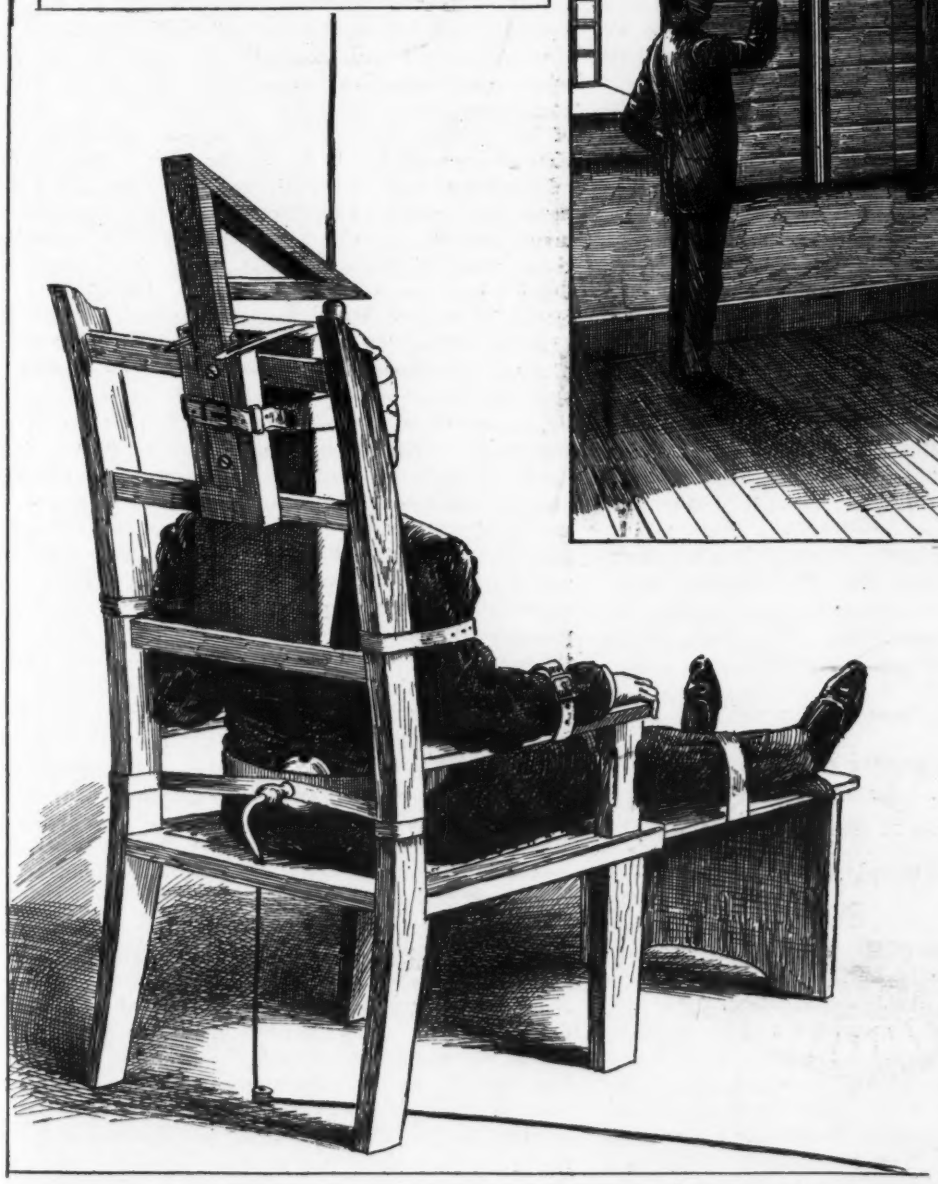
* See United States Patent Specification, No. 300,535, June 17, 1884.

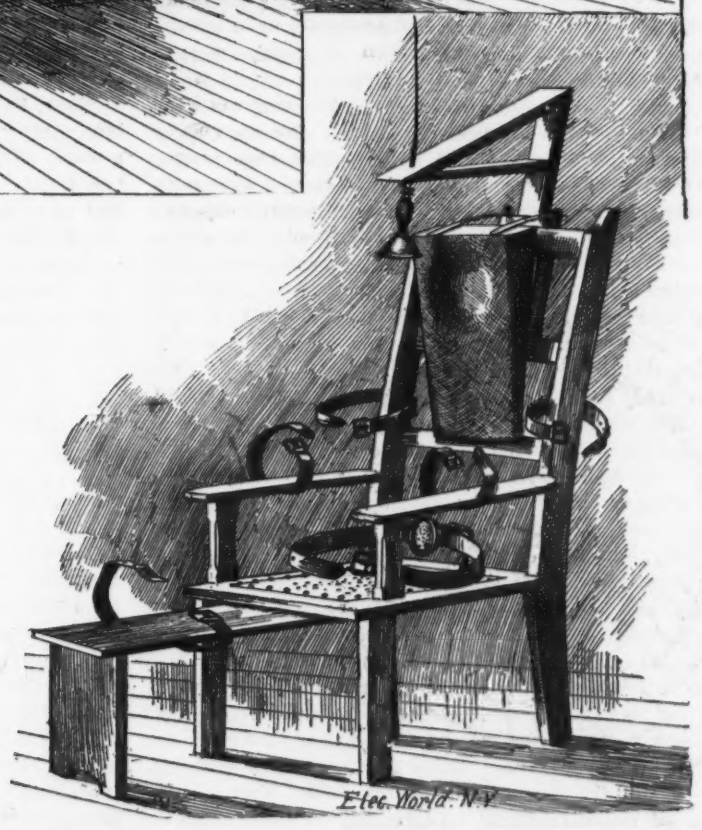
The Execution of Kemmler by Electricity.

On the morning of Wednesday, August 6, 1890, in the State prison at Auburn, N. Y., in the presence of a small company of persons officially selected as witnesses of the event, occurred the first experiment in administering legal death by means of the electric current. The readers of THE ELECTRICAL WORLD are familiar with the long struggle of which this was the close; the earlier investigations in search of a more humane method of administering the death penalty than that of hanging; the reports to the Legislature; the final adoption of the bill establishing what has since been known as "electrocution," and then the arrest, trial, conviction and sentence of William Kemmler, followed by a legal struggle almost unparalleled in the history of criminal law, whose object was to prevent the infliction of the death penalty by the means selected by the Legislature of the State. To these details we need only refer and to the final execution of Kemmler we devote only sufficient space to give our readers a clear understanding of the electrical features of the new method of inflicting the death penalty, with the views of electricians in regard to its adoption elsewhere and its continuation in New York.









THE APPARATUS USED IN THE ELECTRICAL EXECUTION.

[From sketches made at Auburn Prison by our special artist.]

Briefly, then, when the official witnesses of the execution had gathered in the room selected for the purpose, Kemmler was brought in at 32 minutes after six in the morning, and was shortly afterward seated in the death chair. After a few preliminaries, a signal was given to the dynamo room, about 1,000 feet distant at the other end of the prison, and instantly the body of the condemned man seemed to the witnesses to stiffen in the chair. After the current had been flowing for about 17 seconds it was turned off, in answer to a signal from Dr. Spitzka, and those present believed that the execution was complete. Whether this was the case or not will probably never be known. Shortly after the current had been turned off, a muscular contraction produced what seemed to be a violent struggle for breath on the part of the body in the chair. For some seconds there was great excitement, and there can be no doubt that this phenomenon—strange to say quite unexpected on the part of those in charge—caused some, at least, of the official witnesses to lose for the moment their self-possession. The signal, however, to turn on the current once more was promptly given, and this time it was allowed to flow for three and one-half minutes. Everything was over at 6:40, only eight minutes after Kemmler entered the death chamber. Such is, in briefest possible form, an account of what actually took place in the death chamber. Three hours afterward the official autopsy was made by the doctors in attendance.

Of more importance to electricians, however, were the events in the dynamo room, and as to these there is very great doubt. Mr. C. R. Huntley, the well-known electrician, Chairman of the Executive Committee of the National Electric Light Association, and secretary of the Brush Electric Light Company, of Buffalo, was present as one of the witnesses, and he gives his views of the electrical features of the execution in the current issue of THE ELECTRICAL WORLD. His article, which follows this one, is written in a clear, terse and intelligent manner, as was to be expected from a man of Mr. Huntley's reputation, and will be read with deep interest by electricians the world over, especially as it gives the first authentic information on many important points which before were very obscure.

Although we do not approve of publishing the sensational details connected with the death of Kemmler, we felt it to be due to the readers of THE ELECTRICAL WORLD that they should have as clear and accurate a description of the electrical features of the execution as was possible under the circumstances. Our special artist visited the Auburn prison, and was fortunate enough to be permitted to make sketches of the appliances used in the execution. The illustrations published herewith can therefore be absolutely relied upon for accuracy and faithfulness, and will enable the reader to better understand the arrangements from an electrical point of view.

The dynamo room was in the northwest corner of the prison, about 1,000 feet distant from the death chamber. The dynamo was run by an engine in the basement underneath, and two large wires connected it with the fatal chair. They entered the south side of the south wing of the prison through a window in the room containing the switchboard. Two small insulated wires connected the engine room and the death chamber. They were used by the warden in signaling to the engineer.

The switchboard was about 5 feet long and 3½ feet wide. Upon this board were a volt meter, a resistance box, a lamp board with 21 lamps, an ammeter used to measure the quantity of electricity, a regulating switch to govern the lamp board, and the switch itself. One of the big wires entered the switchboard and went directly to the chair; the other passed through the ammeter and was intercepted by the switch. The direct wire and two branches governed the volt meter. One of these branches ran to the resistance box and the other to the volt meter, and the latter and the resistance box were connected by wire. Two electrodes were attached to the death chair, both kept in place by springs. Each electrode ended in a hollow rubber hemisphere containing a sponge in which was embedded the end of the wire. One of these electrodes was fitted to the head of the criminal, and the other was placed directly over the lower part of the spine. There was a back cushion to the chair for the head of the murderer to rest upon. Two straps for each limb, two body straps, and a strap to go around the nose and chin constituted the other furnishings of the chair.

The dynamo was so far distant from the switchboard that a code of signals had to be established. These were: Two taps of the bell, start dynamo; two additional taps, increase the pressure; one tap, stop. The occupants of the dynamo and engine rooms were considerably puzzled over the signals they received. First, the bell rang

twice and the dynamo was set in operation. Five times this signal was repeated. Then came one bell, and the dynamo was stopped. Two minutes later the bell rang twice, and this signal was repeated three times in rapid succession.

Among the many opinions expressed by various experts in regard to the result of the first "electrocution," we give a number, of importance by reason of the weight that their authors' names carry. Dr. Shrady, the editor of the *Medical Record*, of New York, who was present at the execution, had this to say in his journal immediately after the event:

"The long lengthened agony of suspense regarding the efficiency of electricity as a means of executing criminals has finally terminated in the legal killing of William Kemmler. As was reasonably anticipated, death was instantaneous, and, as far as can be judged, the unfortunate subject of the experiment died without pain. The spectacle presented was, however, by no means edifying to such as hoped for improvements on old methods. Although science has triumphed, the question of the humanity of the act is still an open one. But shall we call it a triumph when the object attained was the killing of a fellow-being? Heretofore the proudest claim of science has been to save, or at least prolong, human life and insure for its possessor the greatest enjoyment of its many bounties. In this instance it has been plainly diverted from its course under a paradoxical plea of high humanity, and yet men of science have lent their best efforts in this direction to humor the whims of a few cranks and 'world betterers' who imagined they could make legal murder a fine art and infuse into it an element of sentimentality which might rob it of its atrocity. While we allow that electricity has been a success as far as the killing is concerned, we must also admit that we have gained little if anything over the ordinary method of execution by hanging. The preliminaries of electro-thanasia are far from pleasant to contemplate. Alongside of those for hanging they are pretentiously horrible. There is something more than weird in the preparation of the machine, the deliberate fixation of the victim, the adjustment of the electrode, the thousand deaths in contemplating one; which more than offset the quick though damnable taking off. The horrors, though hidden, are nevertheless felt. There is something else to be thought of than the mere quickness of death. While the latter may have been triumphantly done, the agony of the criminal during the preparation must be terrible as compared with that of hanging. The experiences in the Kemmler case, in spite of all the precautions taken, have shown many difficulties in the way of a general adoption of the method of killing by electricity. It is far from simple in its application. It requires elaborate and careful preparation. It multiplies machinery which, without expert manipulation, is liable to fail in its working and bring about disastrous results. It may be a source of danger to the executioners and spectators. It increases the expense of executions; but worse than all, in the necessary preparation of the victim there is crowded upon him in a few seconds an amount of horror and suspense which holds no comparison with any other forms of rapid demolition save those of being thrust against the muzzle of a loaded cannon or being tied to a dynamite bomb."

Dr. Shrady said in conclusion that the death chair will yet be the pulpit from which the doctrine of the abolition of capital punishment will be preached.

Dr. Louis Balch, who was also present, spoke as follows:

"With many others I was asked by the commission to give my views as to the best of the modes of execution—electricity, hanging, or guillotine. Personally I was in favor of hanging, but having seen the absolute certainty, rapidity, and painlessness with which death can be caused by electricity, my opinions have been changed to favor that mode of legal execution. I do not consider that the failure of the first shock to cause instantaneous death is any proof that this method of execution is futile, for from the first shock the prisoner was virtually dead, suffered no pain, and had no return to consciousness. I think there should be one electrician appointed who would attend all executions and have charge of all electrical apparatus, under the supervision of the officers delegated by law to carry the sentence into effect.

"When the current was put on the only visible effect was the tightening of the muscles and the raising of the lip and nose. There was no symptom of pain by facial expression or muscular action. I believe that sensation was absolutely paralyzed by the first application. The first current was kept on seventeen seconds, the body remaining in a state of contraction during this period. When the current was stopped the body relaxed, apparently lifeless. Death seemed to have taken place, if one could judge from the general appearance of the face and hands and the limp condition of the body, but it proved that the current was not maintained long enough in contact to cause complete death. A few seconds after the connection had been broken signs of life were discovered. Consciousness did not return, but the heart and lungs resumed their functions to a minor extent. The breathing became labored and blowing in character, while some frothy mucus drooled from the mouth. The second application was continued three and a half minutes, and when cut off the man was dead." Dr. Balch considers, however, that if this way of administering the death penalty is to remain the law, there should be a building specially prepared for such purpose, to contain all the apparatus and the room in which the execution takes place. He also believes there should be two dynamos in case of accident to one. This would save the chance of failure of voltage from any irregularity in the engine originally used for power in the prison.

Charles R. Barnes, who had charge of the dynamo at the execution, said:

"The execution of Kemmler was a decided failure, but with the proper precautions it could have been successfully done. In the first place, the dynamos were placed up-stairs on an ordinary wood floor, with no additional precaution to make them strong and secure. The dynamo, when running at full speed, would vibrate the floor from one-half to one inch. The countershaft was placed on a wood framework resting on this floor, and was not lined up properly so that the pulleys would run true. The belts used were new ones, and had not been used enough to get the stretch out of them, so that when the current was turned on the first time, and the extra resistance of the chair circuit, which included Kemmler's body, was thrown on, the belt came very near leaving the pulley. At that time there was not even one-half of the belt on the dynamo pulley, and the armature was brought down so that it was not running much, if any, over half speed. But with the aid of one of the others the man was able to keep the belt from flying off until the signal to shut down. All the time the dynamo was running the slipping of the belt could be heard in the prison yard. If that belt had come off when the current was sent to the chair the result would have been terrible."

Deputy Coroner Jenkins, who performed the autopsy, said that he considered execution by electricity preferable to that by hanging. "In the first place," he continued, "electricity is much more expeditious, and in the second, less painful. I have witnessed five or six hangings, and in no case has the victim been pronounced dead in less than eight or ten minutes. There is always more or less contortion of the body. It took about 43 seconds to kill Kemmler, yet the execution was a bungling one. I think that the man became unconscious as soon as the first current passed through him and that his death was painless.

"We know from the observation of cases where men have revived after electric shocks that the experience is painless. It is like a faint or sudden fit. The first one knows is when he recovers. The execution at Auburn would have been successful had it been entirely in charge of scientific men. Kemmler was not killed by the first shock. He had begun to breathe again when the second current was turned on."

Dr. A. P. Southwick, father of the electrical execution law, said: "There has been a great deal of senseless sentimental talk about the execution. I do not consider that this will be the last execution by electricity. There will be lots of them. It has been proven that the idea is correct, and I think the law is the best one. The execution was a success. Kemmler never knew what happened to him, and died absolutely without pain." The views of Mr. Edison and Mr. Paul D. Cravath are given elsewhere.

The Execution as Seen by an Electrician.

BY CHARLES R. HUNTLEY.

It is with pleasure that I comply with the request of THE ELECTRICAL WORLD to give my observations on the Kemmler electrocution. One of the prime reasons which prompted me to attend this event was that the electrical fraternity would have the benefit, so far as I was able to observe, of what occurred at this electrocution.

The dynamo, as is well known, is one of the Westinghouse type, the exciter being of the usual pattern sent with all dynamos of this make. It was located in the second story of the east wing of the prison, about 1,000 feet from the room wherein the death chair was located. The power was supplied by a 45 h. p. engine, belted to a 2-inch shaft which ran through the dynamo room. On this shaft were a 36-inch pulley and a 30-inch pulley. From the 36-inch pulley was run an 8-inch belt down to a 12-inch pulley on the dynamo, and a 6-inch belt ran from the shaft to the exciter. No voltmeter or ammeter was connected up in circuit at this point. A resistance box was placed at the end, over the exciter. The wires led out through the window up over the roof on porcelain and glass insulators, down across and around the dome of the front of the prison; from there down on the wall into the window of what was known as the original room for the electrocution. This wire was of No. 12 B. & S. gauge, rubber covered, and said to have been made by the Edison Company. On the switchboards were two Cardew voltmeters, both connected up with resistance coils. Both were connected with switches, and between the two was a lamp board, which, I am told, is of the usual type used in the Edison stations. In this were twenty 100-volt lamps of Edison make, and an ammeter of Bergman & Co.'s make was a part of the lower portion of the board.

There were two jaw switches—one known as the fatal switch and the other as the lamp board switch—which were placed on the wall of easy access to the executioner. From the board there ran wires of the same gauge into the chair, one being fastened to the electrode on the bottom, and the other to the electrode on the top. This is all of the electrical apparatus and distribution that I noted. A Mr. Davis was the man in charge. I might say that my curiosity prompted me to go with him to witness the first test of the machinery on Tuesday afternoon. Mr. Davis adjusted the brushes on both dynamo and exciter and then left the apparatus in charge of three convicts who were assistants.

After going back to the switchboard signals were given to start up the dynamo. At that time the voltmeter showed about 1,000 volts. The lamps were in circuit and were about two-thirds candle power. Again in the evening all of the witnesses summoned by law, together with the doctors and professional men, witnessed another test, which was substantially the same as that of the afternoon. There was no record taken of what the voltage was at that time, but an assumption was made that it was from 1,000 to 1,200 volts.

The morning of the execution came, and those who were to witness the first experiment upon human life by the electric current found, in a dimly lighted room, the death chair, and around about the walls in a circle seats for their accommodation. I do not know that it will be of any interest to your electrical readers to record here (inasmuch as the press has given all of that) what took place with reference to the in-coming of Kemmler and his spiritual advisers, but suffice to say that the man who stood before us exhibited the most unconcern of any of the 23 men who were within the room. After being strapped and pinioned to the chair, Kemmler assisting, and to quite an extent, the electrodes at the head and back were securely placed, the strap securely fastened over his face by the warden, the word was given to the three men who were in the room behind a closed door, and we witnessed the effect of the first contact by a contraction, or rather drawing up of his whole body within his bonds. The time by actual count was seventeen seconds. The current then by direction of Dr. Spitzka was turned off, and to all appearances Kemmler was dead. As the doctor said: "There are unmistakable evidences of death about his nose, and I have never known such a condition as is demonstrated on this man except in death." One of the attendants then removed the electrode from his head, and those who were advocates of the killing by electricity were elated beyond expression. The look of entire satisfaction which spread over the countenances of some of the learned doctors was an indication of the joy that their labors had brought them in the death of Kemmler, apparently so painless and still. The next sound that was heard was of Dr. Spitzka saying: "This man is not dead. Turn on the current." The electrode, in a hurried manner, was again applied to his head and the signals were sent out by one of the attendants in the room to start up the machinery. This was done. How soon I cannot say. The laymen were all in confusion at the horrible sounds that were coming from the man who had been pronounced dead. Words fail me with which to give you the faintest idea of what these were. There were men in that room who had witnessed executions and had seen death in various forms, but each and every one of them was horror stricken at this sudden change in the condition of the culprit. Various reports have been made as to the length of time of the second contact, but it has been my privilege to be associated somewhat with the gentleman who was in the dynamo room while the machine was in operation. He tells me that after the first shock the signals were given to shut down. This was done by the convicts. Then a short space—perhaps two minutes—and the signal was given to start again. Instantly another signal was given for more speed, and so on until the dynamo was running, and as he stated, it was fairly jumping from the floor. I forgot to mention that during the time of the second shock the circuit was made and broken three times. At each of these periods the dynamo would be nearly stopped, and the belt after the first shock was nearly thrown off the dynamo pulley. Then a convict was instructed to hold the belt on each side of the pulley, which was done during the time that the dynamo was running, which was about three and a half minutes. Added to the horror of the sounds emitted by the so-called dead man, were what the doctors said were convulsions, but whatever it may be called, convulsions or not, I am told by one of the physicians as reputable as any there that life did exist in the man, though not sensibility, after the first shock. The electrode at his back had become loosened, admitting of arcing, and at this point of contact the flesh was literally roasted. The stench of burning flesh was almost unbearable to those of us unfamiliar with such things.

What occurred in the lamp room no one will ever know beyond the three persons present. I endeavored to ascertain what the voltage was, but I did not succeed in getting any information, and I question very much whether Mr. Davis himself, who had charge of the electrical appliances, knows to what voltage Kemmler was exposed at either time.

From an electrical standpoint there was nothing gained to show what amount of current it takes to kill. No data of either the electrical or mechanical apparatus was taken, and whoever assumes to say what the voltage was that Kemmler received must guess between 800 and 2,000.

Some New Types of Alternating Current Motors.

Among the few prominent workers in the development of the alternating current motor is Mr. Nikola Tesla. His early work in this line, presented in a paper read before the American Institute of Electrical Engineers two years ago,* justly excited widespread interest not only because of what had already been accomplished but for the influence which his suggestive researches would have in stimulating others to take up similar lines of investigation. Since that time Mr. Tesla has not relaxed his efforts to produce a more efficient alternating current motor, and each of his inventions has been a step in advance along a line where progress has been extremely difficult.

The latest types of alternating current motor produced by Mr. Tesla have been designed with a view to their economical adaptation to a two-wire system of alternating current distribution, without the use of a commutator. He has utilized for this purpose the well known fact that the magnetization of the entire core of an electro-magnet does not take place instantaneously upon the passage of a current through the surrounding coil. This phenomenon is attributed by Mr. Tesla to the fact that the action of the current is to energize first those laminæ or parts of the core nearest the surface and adjacent to the exciting coil, and from thence the action progresses toward the interior. A certain interval of time therefore elapses between the manifestation of magnetism in the external and the internal sections or layers of the core. If the core be thin or of small mass, this effect may be inappreciable; but in the case of a thick core, or even of a comparatively thin one, if the number of alternations be very great, the time interval occurring between the manifestations of magnetism in the interior of the core and those parts adjacent to the coil is more marked, and in the construction of such apparatus as motors which are designed to be run by alternating or equivalent currents, it has been found desirable and even necessary to give due consideration to this phenomenon and make special provisions in order to obviate its consequences.

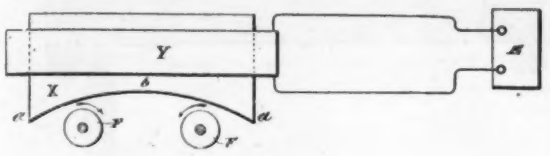


FIG. 1.

Mr. Tesla takes advantage of this well known phenomenon and utilizes it in the construction of his motors, even using special means by which the action may be exaggerated and rendered more pronounced. This he attains by constructing a field magnet in which the parts of the core or cores that exhibit at different intervals of time the magnetic effect imparted to them by alternating or equivalent currents in an energizing coil are so placed with relation to a rotating armature as to exert upon it the attractive effect successively in the order of their magnetization. By this means he secures a similar result to that which he has attained in other forms of motor in which by means of one or more alternating currents a rotation or progression of the magnetic poles or points of maximum attraction of the field of force is secured.

A diagrammatic representation of a very simple form of motor, by means of which Mr. Tesla illustrates the application of this principle, is shown in Fig. 1. Here *X* represents a large iron core made up of any number of thin laminæ of soft iron or steel. If we consider the magnetic conditions existing in this core at any point, as *b*, at or near the centre, and any other point, as *a*, nearer the surface, it will be seen that when a current impulse is started in the magnetizing coil *Y*, the section or part at *a*, being close to the coil, is immediately energized, while the section at *b*, which may be said to be "protected" by the intervening layers between *a* and *b*, does not at once exhibit its magnetism. However, as the magnetization of *a* increases, *b* becomes also affected, reaching finally its maximum strength some time later than *a*. Upon the weakening of the current the magnetization of *a* first diminishes, while *b* still exhibits its maximum strength; but the continued weakening of *a* is attended by a subsequent weakening of *b*. Assuming the current to be an alternating one, *a* will now be reversed, while *b* still continues of the first imparted polarity. This action continues, the magnetic condition of *b* following that of *a* in the manner above described. If an armature—for instance, a simple disc *F*, mounted to rotate freely on an axis—be brought into proximity to the core, a movement of rotation will be imparted to the disc, the direction depending upon its position relatively to the core, the tendency being to turn the portion of the disc nearest to the core from *a* to *b*, as indicated in Fig. 1.

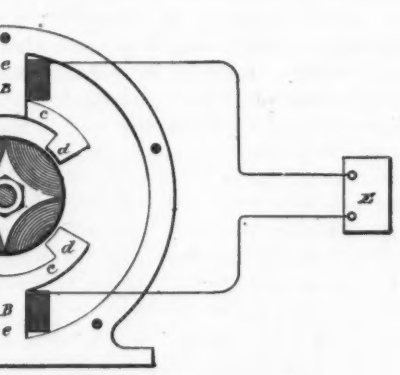


FIG. 2.

Fig. 2 shows a side elevation of a form of motor in which Mr. Tesla embodies this principle of operation. Fig. 3 is a vertical section of the same through the axis of rotation. Here *A* represents a circular frame of iron, and from its interior, at diametrically opposite points, the cores project. Each core is composed of three main parts, as shown in the section in Fig. 3, and they are similarly made with a straight portion *e*, around which the energizing coil is wound, a curved arm or extension *c* and an inwardly projecting pole *d*, as seen in fig. 2. Each core is made of two exterior parts with their polar extensions reaching in one direction and a central part between the other two and with its polar extension reaching in the opposite direction. These cores are wound with coils which are connected in the same circuit either in parallel or series and supplied with an alternating current by a generator *E* represented diagramatically. Between the cores or their polar extensions is mounted an armature wound with magnetizing coils that are closed upon themselves, similar to those in the earlier types of Mr. Tesla's motors.

The operation of the motor is as follows: When a current impulse is sent through the magnet coils the sections of the cores on the surface and in close proximity to the coils are immediately energized. The interior sections, on the other hand, are protected from the magnetizing influence of the coil by the interposed layers of iron. As the magnetism of the exterior increases, however, the sections

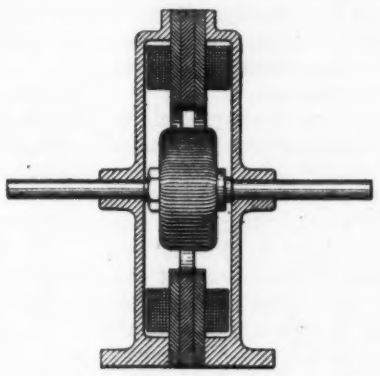


FIG. 3.

on the interior are also energized, but they do not attain their maximum strength until some time after the external sections of the core have reached their maximum magnetization. Upon the weakening of the current the magnetic strength of the exterior layers first diminishes while the interior sections have still their maximum strength; but as they continue to weaken, the interior sections are similarly weakened. The interior and exterior layers of iron may, therefore, be considered as separate field magnets, being extended so as to act on the armature in the most efficient positions, and the effect is similar to that obtained in Mr. Tesla's other form of motor, viz., a rotation or progression of the maximum points of the field of force. Any armature, such, for instance, as a disc mounted in this field, would rotate from the pole first to exhibit its magnetism to that which exhibits it later.

Following out these ideas still further Mr. Tesla has applied them to a class of motors in which two or more sets of energizing magnets are employed and in which by artificial means a certain interval of time is made to elapse between the respective maximum or minimum periods of their magnetic attraction or effect. In this case Mr. Tesla employs a motor with two sets of energizing or field magnets, each wound with coils connected with a source of alternating currents, but forming two separate paths or circuits. The magnets of one set are protected to a certain extent from the energizing action of the current by means of a magnetic shield or screen of laminated iron interposed between the magnet and its energizing coil.

The shield is properly adapted to the conditions of particular cases so as to shield or protect the main core from magnetization until it has become itself saturated and no longer capable of containing all the lines of force produced by the current. By this means it will be seen that the energizing action begins in the protected set of magnets a certain arbitrarily determined period of time later than in the other, and that by this means a practically economical difference of magnetic phase may readily be secured.

Fig. 4 shows the simplest form of this type of machine. The cores *B* form one set of magnets and are energized by coils *D*, while the cores *C*, forming the other set, are energized by coils *E*, and the coils are connected in series with one another, in two derived or branched circuits *F* and *G* respectively. Each coil *E* is surrounded by a magnetic shield *H*, which is composed of an annealed, insulated, or oxidized iron wire wound on the coils in the manner indicated, so as to form a closed magnetic circuit around the coils and between the same and the magnetic cores *C*. Between the pole pieces or cores *B C* is mounted the armature, which in this case is of the closed-circuit coil type.

The operation resulting from this arrangement is as follows: If a current impulse be directed through the two circuits of the motor, it will quickly energize the cores *B*, but not so the cores *C*, for the reason that in passing through the coils *E* there is encountered the influence of the closed magnetic circuits formed by the shields *H*.

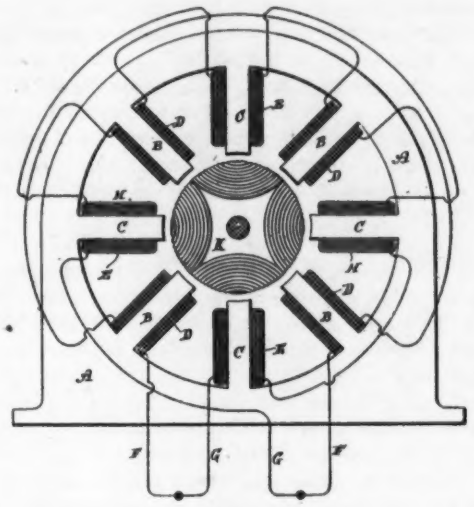


FIG. 4.

The first effect is to effectively retard the current impulse in circuit *G*, while at the same time the proportion of current which does pass does not magnetize the cores *C*, which are shielded or screened by the shields *H*. As the increasing electromotive force then urges more current through the coils *E*, the iron wire *H* becomes magnetically saturated and incapable of carrying all the lines of force, and hence ceases to protect the cores *C*, which become magnetized, developing their maximum effect after an interval of time subsequent to the similar manifestation of strength in the other set of magnets, the extent of which is arbitrarily determined by the thickness of the shield *H*, as well as by other conditions. It will be seen, therefore, that the apparatus or device acts in two ways. First, by retarding the current, and second by retarding the magnetization of one set of cores.

Fig. 5 shows another form of motor which embodies the same principle, and is similar in all respects to that described above, except that the iron wire *H*, which is wrapped around the coils *E*, is in this case connected in series with the coils *D*. The iron wire coils are connected and wound so as to have little or no self-induction, and, being added to the resistance of the circuit *F*, the action of the current in that circuit will be accelerated, while in the other circuit *G* it will be retarded.

Still another type of motor, Fig. 6 and 7, constructed by Mr. Tesla, is one with a field magnet having two sets of poles or inwardly projecting cores, and placed side by side so as practically to form two fields of force, and alternately arranged, that is to say, with the poles of one set or field opposite the spaces between the other. The free ends of one set of poles are then connected by means of laminated iron bands or bridge pieces of considerably smaller cross-

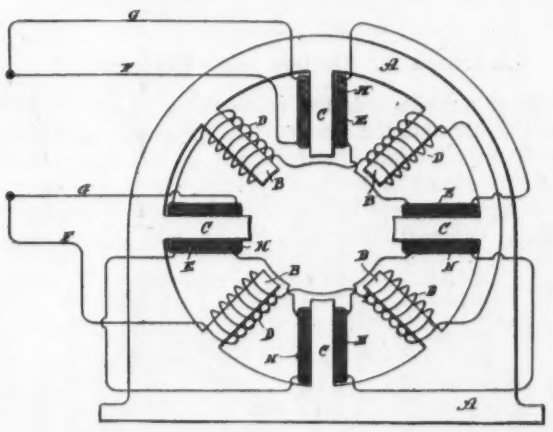


FIG. 5.

section than the cores themselves, so that the cores all form parts of complete magnetic circuits. When the coils on each set of magnets are connected in multiple circuits from an alternating machine, electromotive forces are set up in each circuit simultaneously, but the coils on the magnetically bridged or shunted cores will have, by reason of the closed magnetic circuits, a high self-induction which retards the current, permitting at the beginning of each impulse but little current to pass. On the other hand, no such opposition being encountered in the other set of coils, the current passes freely through them, magnetizing the poles on which they are wound. As soon, however, as the laminated bridges become saturated and incapable of carrying all the lines of force, which the rising electromotive force, and consequently increased current, produce, free poles are developed at the ends of the cores, which, acting in conjunction with the others, produce rotation of the armature.

Figs. 6 and 7 show respectively a side elevation and a vertical cross section of this form of motor. The frame of

* See THE ELECTRICAL WORLD, Vol. XI., page 281, June 2, 1888.

the motor *A* is built up of sheets of iron punched out to the desired shape and bolted together with insulation between the sheets. When complete the frame makes a field magnet with inwardly projecting pole pieces *B* and *C*. To adapt them to the requirements of this particular case, these pole pieces are out of line with one another, those marked *B* surrounding one end of the armature, and the others *C* the opposite end, and they are arranged alternately; that is to say, the pole pieces of one set are in line with the spaces

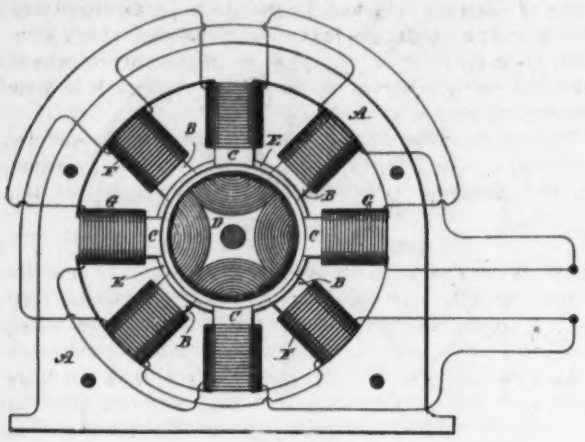


FIG. 6.

between those of the other sets. The armature is of the cylindrical closed circuit type. The pole pieces *C* are connected or shunted by bridge pieces *E*. The coils *F* and *G* are connected in series, respectively, in two circuits which are branches of a circuit from an alternating machine, and they are so wound that the circuit of coils *G* will have a higher self-induction than the other circuit or branch.

The function of the shunts or bridges *E* is that they shall form with the cores *C* a closed magnetic circuit for a current up to a predetermined strength, so that when saturated by such current and unable to carry more lines of force than such a current produces, they will, to no further appreciable extent, interfere with the development by a stronger current of free magnetic poles at the ends of the cores *C*.

In such a motor the current is so retarded in the coils *G* and the manifestation of the free magnetism in the poles *C*

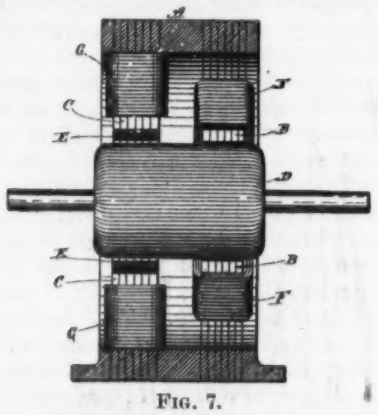
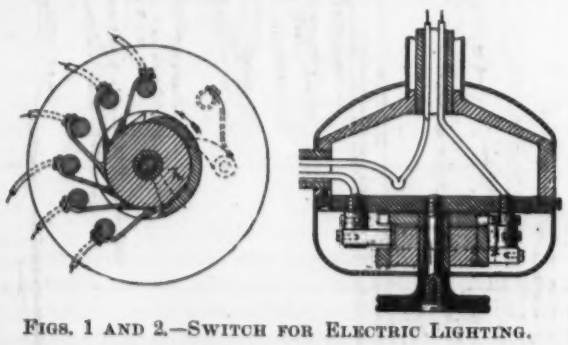


FIG. 7.

is delayed beyond the periods of maximum magnetic effect in poles *B*. The result is that a strong torque is produced and the motor operates with approximately the power developed in a motor of this kind energized by independently generated currents differing by a full quarter phase.

A Switch for Electric Light Fixtures.

In no way, perhaps, is the convenience of the electric method of illumination more evident than in the great variety of methods that are applicable in the distribution of the current and in the facility with which the lights, wherever placed, may be controlled by suitably arranged switches. One method of securing an independent con-



FIGS. 1 AND 2.—SWITCH FOR ELECTRIC LIGHTING.

trol of the individual lights in an electrolier from a single switch is shown by the accompanying cuts, which exhibit sectional and plan views of one form of a switch devised by Mr. Sigmund Bergmann, of this city.

The object of the arrangement shown is to provide an electric light fixture carrying several lamps with a switch by the movement of which one or all or any desired intermediate number of its lamps may be placed in circuit and lighted, or cut out of circuit and extinguished. The switch is one having a continuous movement in one direction, by which movement the lamps are thrown successively into circuit, and then successively out of circuit. Fig. 2 shows a vertical section of the lower portion of an electrolier to which one form of the switch is fitted. Fig. 1 is a plan view showing contacts for six branches to one or more lights each. The current is led to the switch through the spring and contact piece shown on the right, and is carried to the lights by a conducting band of metal upon which the contact piece rests. As the switch is turned from the position shown in Fig. 1, the contact springs shown upon the left are brought to bear upon an insulating piece, and the lights to which they lead are therefore cut out of circuit. Several modifications of the switch as shown in the illustrations are possible, and will readily suggest themselves to many electric light men, to whom this little piece of apparatus will prove very useful.

The Tesla Transformer.

An interesting type of transformer has recently been designed by Mr. Nikola Tesla for the purpose of securing a phase difference between the primary and secondary currents adapted to the operation of his new types of alternating current motors, and also to secure a constant current in the primary for all loads imposed upon the secondary. Instead of bringing the primary and secondary coils or circuits of a transformer into the closest possible relations, as

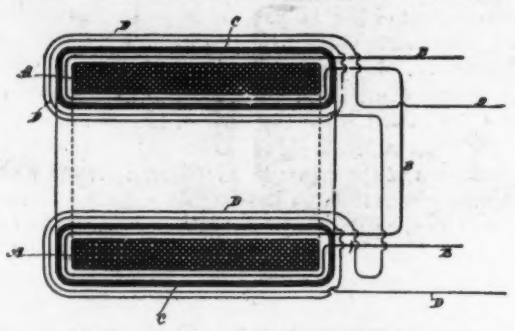


FIG. 1.—TESLA TRANSFORMER.

has hitherto been done, he protects in a measure the secondary from the inductive effect of the primary by surrounding either the primary or the secondary with a comparatively thin magnetic shield or screen.

Under these conditions, as long as the primary current has a small value the shield protects the secondary, but as soon as the primary current has reached a certain strength, which is arbitrarily determined, the protecting magnetic shield becomes saturated and the inductive action upon the secondary begins. It results, therefore, that the secondary current begins to flow at a certain fraction of a period later than it would without the interposed shield, and since this retardation may be obtained without necessarily retarding the primary current also, an additional lag is secured and the time interval between the maximum or minimum periods of the primary and secondary currents is increased.

Fig. 1 is a cross-section of a transformer embodying the above idea. *A A* is the main core of the transformer composed of a ring of annealed iron wire. Upon this core is wound the secondary circuit *B B*, covered with a layer of annealed iron wires *C C*, wound in a direction at right angles to the secondary coil. Over the whole is then wound the primary coil *D D*.

From the nature of this construction it will be obvious that as long as the shield formed by the wires *C* is below magnetic saturation, the secondary coil is effectually protected or shielded from the inductive influence of the pri-

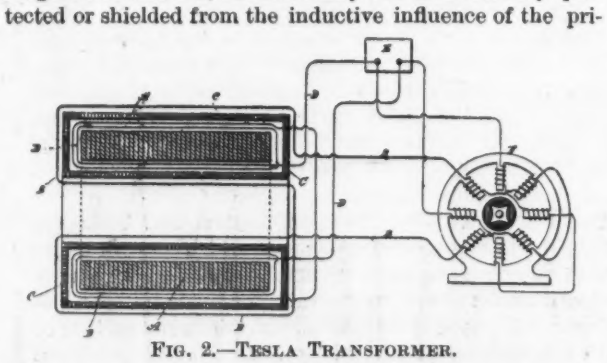


FIG. 2.—TESLA TRANSFORMER.

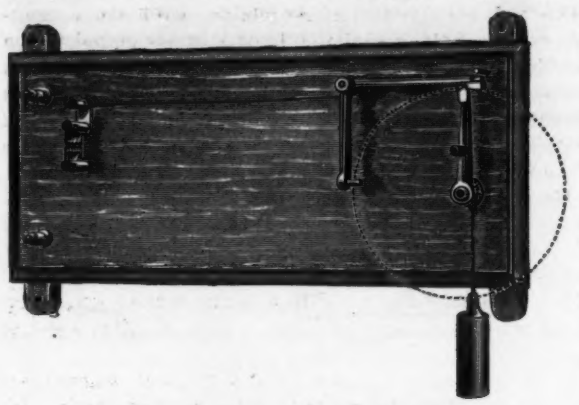
mary. When the strength of the primary reaches a certain value, the shield *C*, becoming saturated, ceases to protect the secondary from inductive action and current is in consequence developed therein. For similar reasons, when the primary current weakens, the weakening of the secondary is retarded to the same extent.

Fig. 2 shows a modified form with connections to a two-circuit alternating current motor. The core *A* is built up of insulated iron plates. The primary circuit *D* is wound next to core *A*. Over this is applied the shield *C*, which in this case is made up of thin plates of iron properly insulated and surrounding the primary, forming a closed magnetic circuit. The secondary *B* is wound over the shield *C*.

Bain's Hot Wire Lightning Arrester.

A lightning arrester, in the opinion of many, should protect the circuits when idle with as great fidelity as when the dynamos are in operation; and it should be so constructed as to have no self-induction, and, therefore, it should have no magnetic coils or condenser plates in the circuits. An absolute break of sufficient distance to interpose enough resistance to open the arc should be made with every flash of lightning that comes in on the lines; these breaks should be absolute and not depend upon any equilibrium-establishing mechanism for the length of break; they should be automatic, so as to take care of a number of flashes in rapid succession without any manual attention; and a further requirement is that they should protect circuits used for alternating currents with the same degree of promptness and certainty as circuits used for direct currents.

Such a device has recently been designed and patented



A HOT WIRE LIGHTNING ARRESTER.

by Mr. Foree Bain, of Chicago, and is being sold by the Central Electric Company. The cut shows how the circuit to ground is opened through the expansion of a small iron wire, due to the passage of the flash or the dynamo current. The iron wire forms a part of the circuit to ground, the lightning leaves the line at the comb, passes over this wire which it expands, a spring acting against the wire causes the trigger to unlatch the metallic winch, which forms part of the circuit; to this winch is attached a string, wound round a drum, which is a part of the winch; to the string is hung a small weight which causes the winch to revolve when released. When the wire has been expanded by the passage of current, the winch makes three-quarters of a revolution and stops against an insulated stud on the arm, part of which forms the trigger; it rests against this insulated stud, leaving the circuit to ground open until the wire contracts sufficiently to release it from this stud,

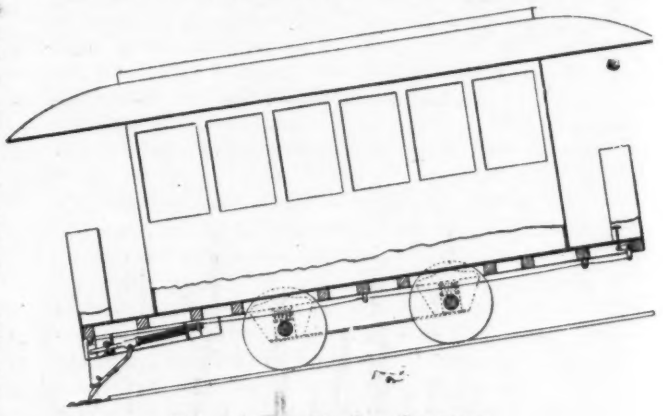


FIG. 1.—FLOOD'S CAR STARTER.

when it completes the revolution and once more rests against the trigger and is ready for another flash to repeat the operation.

Flood's Car Starter for Electric Cars.

This car starter consists of a dog or engaging bar, the end of which is pointed and bent down to facilitate its engagement in the pavement or ground between the tracks, and is pivoted to a sliding bar running under the rollers, which reduces the friction to a minimum.

On the sliding bar is a spring which compresses with a load, and this compression will be proportional to the load. As soon as the car starts forward the resilient force of the spring aids in propelling the car in its forward movement. Fig. 1 shows a sectional view of the car with starter attached, and Fig. 2 a view of the details of the apparatus.

The dog serves as a check or stop to prevent the car from

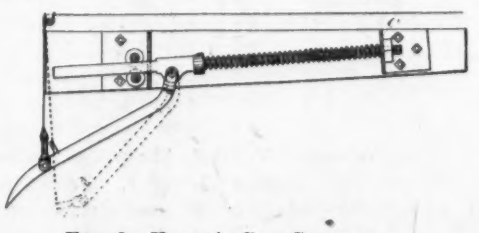


FIG. 2.—FLOOD'S CAR STARTER.

running backward on an up grade, and could and is meant to be used in place of the brake should the brake fail.

It is operated by the driver by raising and lowering a foot lever attached to the dog by means of cable and pulleys. When he wishes to stop on a hill he drops the dog, applies the brake, and when the car stops he relesses it, allowing the weight of the car to rest on the dog. Railway experts can readily see the great advantage over the old way in starting with the brake on. These starters are in use on all of the 32 cars of the Albany Railway Company at Albany, N. Y., and are so satisfactory that no car is allowed on the road unless equipped with one. They are simple, reliable, and easily kept in order, and do not interfere with the wiring or motor mechanism of electric cars, and can be placed on any style of car truck.

An Efficiency Test of the Third Ward Railway at Syracuse, N. Y.

BY G. D. HULETT.

As will be remembered by many, about a year ago Dr. Louis Bell made a test of the Sprague electric railway at Lafayette, Ind., and found that the all day efficiency was but 25 per cent. This means, of course, that of every hundred h. p. developed by the engine, upon the average but 25 h. p. were actually employed in the propulsion of the cars, the remainder being consumed by the friction of engine, generators, motors and gearing, the heating of various portions of the circuits owing to resistance, and also the cores of generators and motors through the action of hysteresis and Foucault currents.

The greater part of this loss occurred in the station itself, as the electrical h. p. delivered to the line was but 41 per cent. of the h. p. of the engine. The latter was a Hamilton-Corliss of 130 h. p., which drove a line shaft, and belted to this were two Edison shunt-wound generators of 30,000 watts capacity each, which supplied the car line.

The results seem to indicate that slow speed engines are ill-fitted to the requirements of street railway work with its constant and sudden variations of load; and it was Dr. Bell's opinion at the time that the conditions of maximum efficiency would be brought about by the use of high speed engines belted directly to the generators, which should be compound wound.

The present test was conducted upon the Thomson-Houston road at Syracuse, N. Y., some time ago by Mr. S. J. Larned and the writer, then students at Cornell University. This road is about four miles in length, connecting Geddes or West Syracuse with the centre of the city, and at the time of the test operated seven cars. The power is furnished by two Armington and Sims engines each of 80 h. p., to which are belted two compound wound Thomson-Houston generators of 60,000 watts capacity, which are run in parallel. The equipment is thus seen to be far more than adequate for seven cars and at present there are several more in operation. For this reason, therefore, the efficiency will be found rather low.

In order to obtain the total electrical output for the day with as much precision as possible, a recording ammeter was constructed, which is shown in perspective in Fig. 1. *S* is a solenoid seven inches in diameter, consisting of 80 turns of cable, having a carrying capacity of 150 amperes, through which the entire current used on the line passes. There are 18 pounds of copper upon this coil. *A* is a soft-iron core 1¼ inches in diameter, which is sucked into the solenoid when the latter is traversed by a current; and directly to this is attached a German silver pen (*P*). *C* is a wooden cylinder 7.65 inches in diameter, which is rotated by means of the weight *W*, and regulated by the clock *K*, so that it makes but one revolution per hour. A paper drum is slipped over *C*, upon which the pen traces a curve the height of which, at any point above the zero line, depends upon the strength of the current flowing through *S*. The magnetic attraction exercised by the solenoid is balanced by the spring *R*, which requires a pull of 10 pounds to produce a deflection of 3 inches; the object in providing so great a force being to render negligible the friction of the core against the bobbin and of the pen

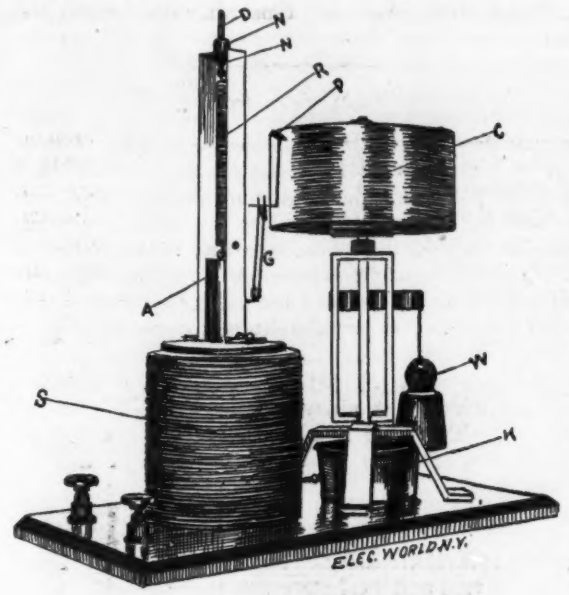


FIG. 1.—RECORDING AMMETER.

on the paper and the guides *G*. The instrument is adjusted by moving the nuts *N N* up or down the threaded rod *D*. Since the circumference of the drum is twenty-four inches and it rotates once in 60 minutes, we see that the space allotted to record the variations is two inches for five minutes; and this was found hardly to suffice.

In order to obtain the mean ordinate for the whole day it was necessary to integrate with a planimeter the space included between the curve and the zero line, thus obtaining the area, which divided by the length, gives the mean height required. As a matter of fact, however, since the deflections of the instrument were not proportional to the current, it was integrated in three parts and each portion read separately from the calibration curve. This is, of course, equivalent to assuming that the calibration curve consisted of three straight l'nes; and this gives a very close approximation to the truth.

By inspecting Fig. 2, which shows the current curve from 1.40 to 2 and from 6.10 to 6.35 P. M. as produced by the instrument, an idea can be obtained of the number, rapidity and magnitude of the variations of current that take place with so few as seven cars in operation. It will be observed that frequently in a few seconds the current will run from zero to 100 or even 150 ampères. It is interesting to note the effect of starting four cars at 6.30 which had remained stationary a few moments previously. The average current for the next five minutes was some 87 ampères. Many other points will be noticed, as the effect of starting, marked by the sharp peaks; rounding curves and mounting grades by large currents which were *held*, as at *A*, *B*, *C*, *D*, *E*. At *F*, *G*, *H* the current was at zero, the result either of all cars being stationary or some descending grades.

The test naturally divides itself into three fairly well defined steps. 1st. To obtain the efficiency of the station. 2d. The efficiency of the line. 3d. The efficiency of the cars. The ratio $\frac{E.H.P.}{I.H.P.}$ was found by choosing favorable moments once about every twenty-five minutes, when the current remained constant for a few seconds, and then reading ammeter and voltmeter, while cards were taken from the engines. At the same time an attempt was made to have the mean *E. H. P.* computed from these readings agree as closely as practicable with that obtained from the recording instrument and mean voltage for the day. In this we succeeded very well, as the mean *E. H. P.* was 34.1 and 32.3, respectively.

The efficiency of the station was thus found to average 62.8 per cent., which may be considered very good when we reflect that nearly double the number of cars could be operated with the same equipment.

The highest efficiency observed was 82 per cent. when the I. H. P. was 108, the highest reading taken. As the I. H. P. was frequently below 30, and the resulting efficiency little above 40 per cent., and sometimes below, it is evident that even when run to its full capacity it is doubtful if the station efficiency would ever rise above 75 per cent.

The efficiency of the line calculated from voltage readings taken at the station and on the line simultaneously was found to average about 91 per cent.

The efficiency of the cars is rather a difficult thing to ascertain. The practice in the Thomson-Houston system is to throw out the whole of the rheostat as soon as practicable after starting, and consequently fully four-fifths of the entire distance traversed by the car is covered with the motor running at its maximum efficiency. This is certainly true at Syracuse, where the conditions are favorable for long runs without a stop in the thinly peopled district lying between Syracuse and Geddes. The method adopted was to find the maximum efficiency of an average car, with the external resistance entirely thrown out, by obtaining the work necessary to cover 350 feet upon the

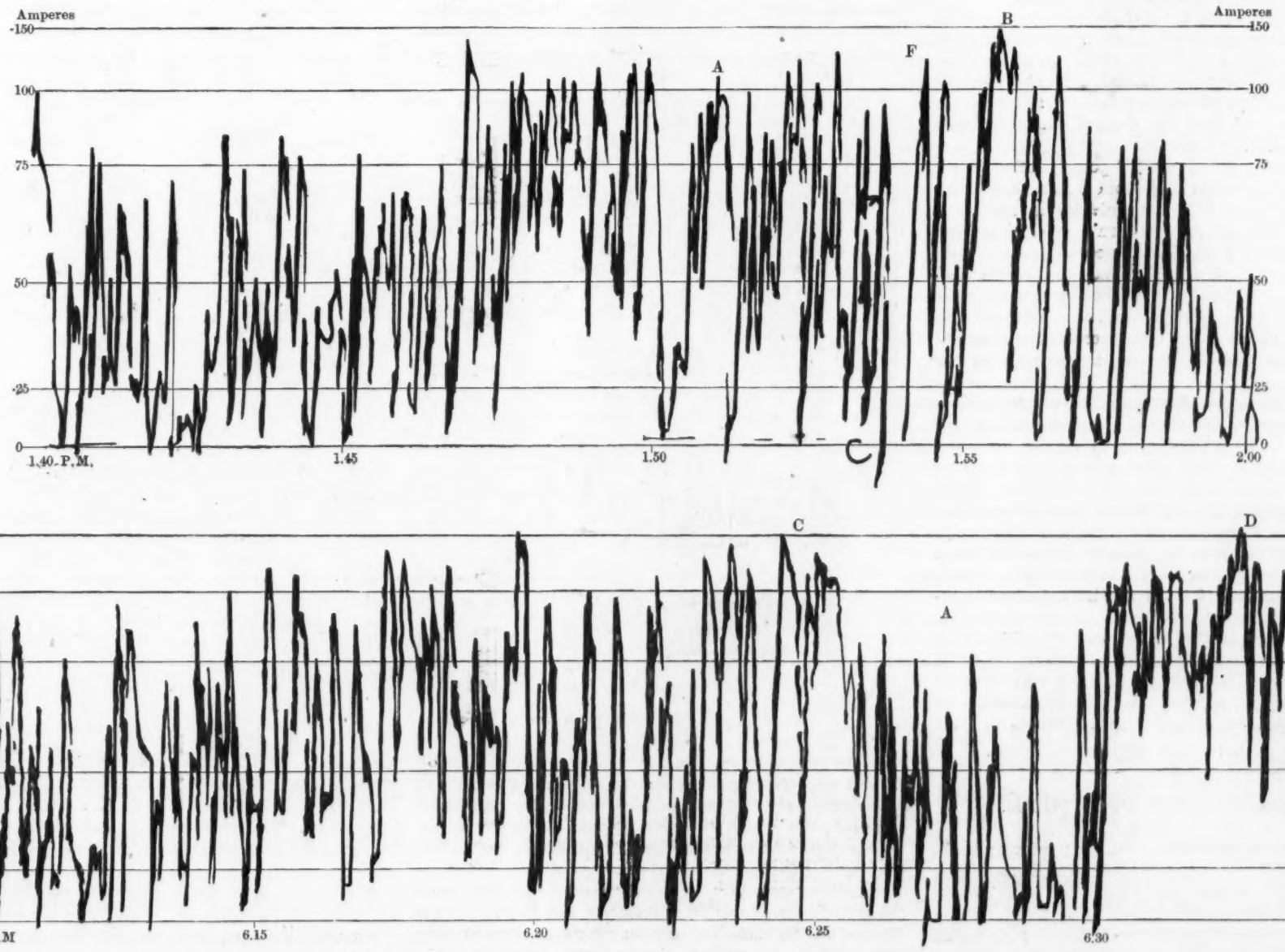


FIG. 2.—ELECTRIC RAILWAY CURRENT CURVES MADE BY RECORDING AMMETER.

level track and the same distance upon a grade averaging 5.76 per cent. By combining the results of these observations, this efficiency was found to be 75.8 per cent. This shows up very well for the motors when we recollect that some 10 per cent. is consumed in the gearing. The efficiency of the car with the rheostat arm in other positions can be computed in the same manner, and then the all-day efficiency estimated from these results and the considerations mentioned in the beginning of the paragraph. In the present case 65 per cent. was taken to represent this mean efficiency, as closely as obtainable from the data at our command.

The efficiency of the entire system may, therefore, be found by taking the product of the efficiencies of station, line and cars, or $62.8 \times 91 \times 65 = 37$ per cent. Comparing this with the 25 per cent. obtained at Lafayette, as has

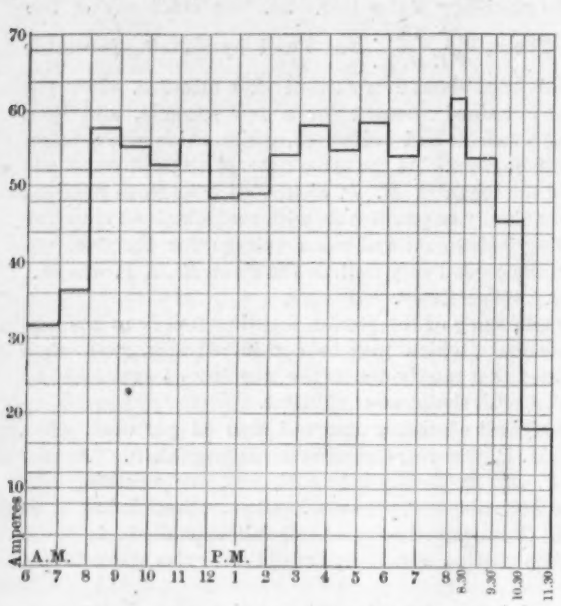


Fig. 3.—Current Curve for the Day.

been stated, it is seen that high speed engines belted directly to the generators have a decided advantage over the slower running Corliss engines which also must waste a considerable amount of power in a line shaft.

Fig. 3 shows the current curve for the day. As will be seen, the maximum demand occurred from 8 to 8:30 P. M., showing that the traffic was heaviest at this hour. There was a decided drop from 12 to 2. The cars were all on at 8 A. M., and the first was switched off at 9 P. M. It will also be observed that the demand was moderately constant from 8 A. M. to 9:30 P. M.

The coal consumption was 5,500 pounds. But steam was supplied to an adjacent shop from 7 A. M. to 6 P. M., and deducting 700 pounds as the equivalent amount used there, we have 4,800 required by the railway. The average horse power for the day was 51.4, hence the coal per indicated horse power hour was 5.3 pounds and per electrical horse power hour 8.4 pounds. Were the plant run up to its normal capacity these figures would be considerably reduced. As the cars ran 98 miles per day the electrical horse power hours per car mile are easily computed and found to be .82.

One point incidentally noticed in taking voltage readings upon the line was that the curves consumed more power than the grades. The lowest voltage observed upon the heaviest grade was 381, while 360 was read when rounding a curve upon a slight incline, and again while a car between the test car and the station was passing round the same curve. Since the drop in voltage is mainly due to the resistance of the line, the demand for current must have been very great. The practice of keeping the curves lubricated is a good one, for the friction is thus much reduced.

The mean voltage at the station was 487, although it frequently ran up above 500 and fell below 470. The greatest current was 225 ampères, and 200 was observed several times; but in all cases these large currents were held at the longest but a few seconds before a drop occurred.

A Prominent Southern Power Station.

The rapid growth of the electric railway industry in the Southern states has led to the establishment of some very finely designed power stations. One of the most prominent installations made by the Thomson-Houston Electric Company is the power station built for the Knoxville Street Railroad Company, Knoxville, Tenn.

The building is one story, made of brick, and divided into boiler and engine and dynamo rooms. The steam plant consists of four steel tubular boilers built for high pressure, to be operated at from 115 to 125 pounds pressure, with furnaces designed for burning a cheap grade of slack coal. Economizers are also provided for utilizing the waste gases in bringing the feed water up to the boiling point before it is pumped into the boilers. Four ways of feeding the boilers are made use of, and so arranged that in case of accident to any one of them, the operation of the steam apparatus would in no way be impaired.

The engines are of the cross-compound condensing Corliss type and so arranged that each pair, which may be considered as one engine, can be operated as a twin engine, and in case of accident either side can be run alone. Each side can also be worked high or low pressure, so that provision is made for operating the plant, even though half of the engine is undergoing repairs. This is said to be the first plant of its kind in the world which has been erected for electric railway purposes, and very satisfactory results are anticipated from it. Each engine will carry its full load under the varying conditions of railway work on an evaporation of 13 pounds of water per horse power per hour. The engines are of extra large proportions throughout, so as to withstand the severe service incidental to railway work.

The electric apparatus comprises eight Thomson-Houston railway generators, and the usual appliances for their operation. Each generator is arranged so as to be thrown in or out of action without interfering in the least with the operation of the remainder of the plant. The engines, boilers and piping were furnished by C. & G. Cooper, of Mt. Vernon, O., and the counter-shafting by the Holyoke Machine Company, of Worcester, Mass. The plant is rapidly nearing completion, and will be in operation some time this month. The installation was designed by Mr. L. H. McIntyre, of the railway engineering department of the Thomson-Houston Electric Company. The electric railway for which this plant is designed is 3.40 miles in length, and will operate five motors cars. The road is confidently expected to be both an electrical and a financial success.

Electrical Distribution by Transformers from Central and Eccentric Stations.*

BY DR. J. A. FLEMING, M. A.

§ 6. *Central Station at Rome.*†—In very fully describing this station in 1889, Prof. G. Forbes‡ called it the "finest example of an alternating current central station;" and it well deserves this commendation. Since it was described by him it has been increased by the addition of two more large 600-h. p. engines and dynamos, and has now a complement of plant equivalent to a total output of 24,000 16-c. p. incandescence lamps. The electric lighting of Rome is carried out by the gas company, which has enlarged its operations and exists under the denomination of the Società Anglo-Romana per l'Illuminazione di Roma col Gas ed altri sistemi. The Directors of this company were

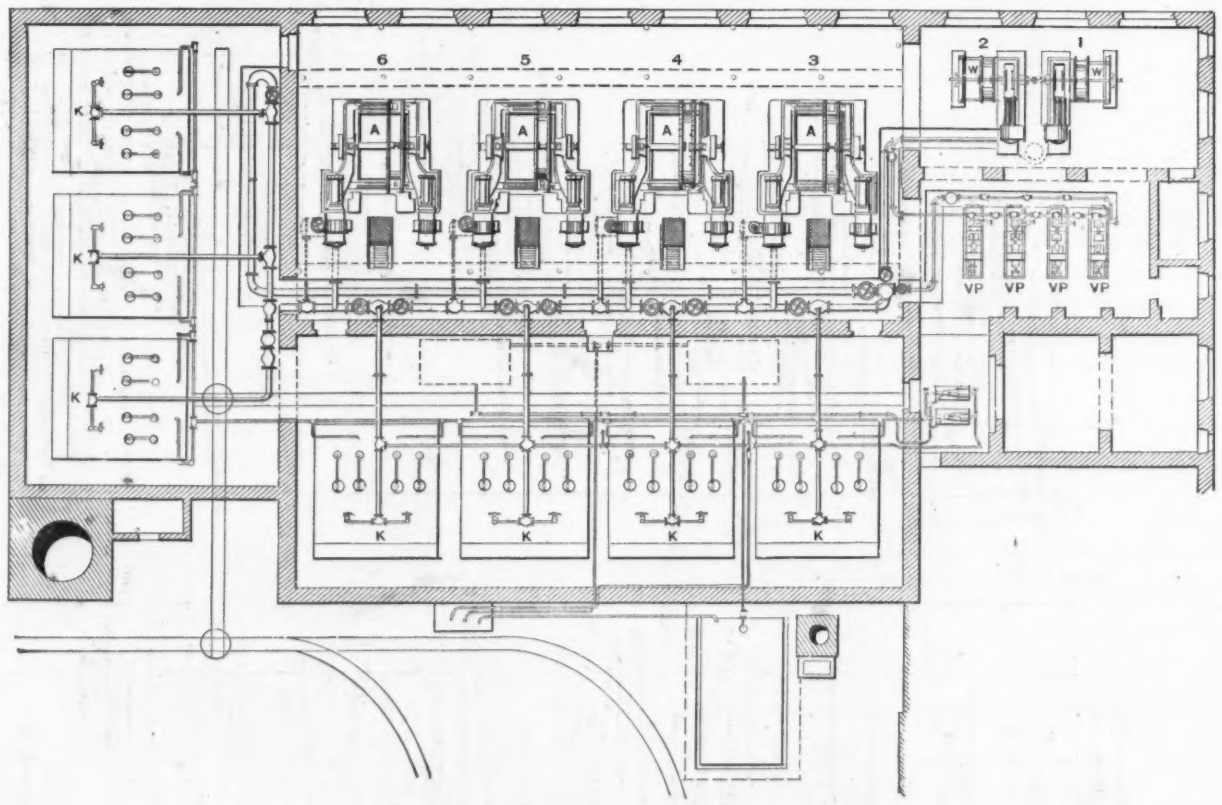


FIG. 17.—CENTRAL STATION AT ROME.

wise and far-seeing enough to recognize the necessity of dealing with the electric light as an ally or as a rival, and in the spring of 1886 commenced operations for the supply from the gas works of the electric current by the Ganz alternating system. The gas works at Rome are in the Via dei Cerchi, near the Tiber, under the shadow of the Mount Palatine, and occupy a position in the region of old Rome, near the site of the ancient Circus Maximus; and in forming the foundations of portions of the heavy dynamo machinery some of the old arches of the Circus were exposed. The plan of the station is shown in Fig. 17, from which the general disposition of the machinery can be seen. The Central Station plant consists of two similar small alternators of 80,000 watt-power, giving a maximum current of 40 ampères, at a pressure of 2,000 volts, which are coupled direct to engines of 125 h. p., and of four large alternators of 320,000 watt power, each giving a maximum current of 160 ampères at a pressure of 2,000 volts. The large dynamos are coupled direct to compound steam engines working up to 600 h. p. The two smaller machines will be referred to as No. 1 and No. 2, and the four larger machines as No. 3, No. 4, No. 5 and No. 6, as shown in the plan. The four larger machines are not all similar in details. No. 3 and No. 4 are sister machines, and also No. 5 and No. 6; but the last two have many improvements not present in the former two. Commencing our description with the first two, or smaller machines, these two dynamos were placed in position and began to be used in the autumn of 1886. The general view of these machines is shown in Fig. 19. The engines are single cylinder, high-pressure engines by Gebrüder Sulzer, of Winterthur and Ludwigshafen. The speed is 250 revolutions per minute. These horizontal engines are built on a common bed-plate with the dynamo, and the revolving field-magnet of the dynamo forms the flywheel of the engine. The engines can be worked up to 150 h. p. There are 20 coils in the fixed armature, and 20 poles in the stellate field-magnet, and in the armature all the coils are joined in series, each giving 100 volts, or 2,000 in all. In the field-magnets the coils are arranged in two series of 10 coils each, joined in parallel. The alternations are 5,000 per minute, or about 42 complete periods per second. These dynamos are auto-excited by a rectified alternating current and commutator, as above described, taking current from the secondary circuit of a field transformer, of which the primary coils are in connection with the armature of the alternator. The larger dynamos (placed in position and started in November, 1887), No. 3 and No. 4, are separately excited alternators, coupled direct to 500 h. p. compound engines by Van Den Kirchoffe, of Ghent. These last have elaborate expansion valve gear of Corliss type, and also centrifugal governors of the usual kind; they have also starting gear. The dynamo is placed between the high-pressure and low-pressure cylinder, so that the field-magnet is slung in the centre of the steel main shaft. The ring-shaped armature frame has massive projections or lugs on either side, supported by, and traversing in, guide bars like the bed of a lathe, and it can be traversed laterally by a screw, so as to move it off from and expose the field-magnet revolving in the interior. The interior diameter of the armature ring frame is about 9½ ft., and the over-all diameter of the stellate field-magnet rather more than 9 ft. In the dynamos No. 3 and No. 4 the field-magnets have solid cast-iron cores and wrought-iron polar caps or projections; and these magnets, 40 in number, are placed round the periphery of an iron wheel keyed on the main shaft. The armature cores are built up of iron plates of thin sheet iron, with interposed paper, as described in a former section.

The two smaller dynamos, No. 1 and No. 2, also have armatures built in this way with divided iron cores, and with solid cast-iron field magnet cores having wrought iron polar expansions. In the armature of dynamos No. 3 and No. 4 there are 40 coils, each generating 50 volts, and the whole of them are joined in series. In the field magnets the 40 coils are joined up so that there are two series of 20 coils in each, and the two series are joined in parallel. The engines make 125 revolutions per minute, producing, therefore, an alternating current of 5,000 alternations per minute, or 42 complete periods per second. The armature coils will carry safely 200 ampères, but their normal load is about 160. The copper wire on the armature and magnet coils is six millimetres in diameter, or about one quarter of an inch.

The last two large machines, No. 5 and No. 6, are generally very similar to No. 3 and No. 4. They are driven

*Continued from The Electrical World, Aug. 9, 1890.

†The author desires to acknowledge his indebtedness for the information on the details of this Central Station at Rome to Signor C. Poucham, and also to Signor de Strens, Chief Engineer, who granted him every opportunity for examining the working of this interesting installation.

‡"Some Electric Lighting Central Stations in Europe, and their Lessons." *Journal of Institution of Electrical Engineers*, Vol. XVIII., 1889, p. 172.

direct by compound 500 h. p. engines by the Erster Brünner Maschinen Fabrik, of Austria; and in this case also the dynamo field magnet is slung as a flywheel in between the high-pressure and low-pressure cylinder. In order to give space for the stellate magnet and annular armature frame, a pit is formed between the high-pressure and low-pressure part of the engine. These last engines have governors of the type employed in the well-known Armington & Sims engine, in which the lead of the single eccentric is shifted and controlled by the outward movement of two massive weights contained in the interior of a pulley-shaped governor wheel. This governor is, for convenience, placed on the outside end of the main shaft of the engine. The general appearance of these last two 500-h.-p. dynamos is shown in Fig. 20. These engines have been found to do their work remarkably well, and to govern steadily. The general principle of this centrifugal governor is that of causing a change of speed of the engine to alter the lead of the slide valve and so cut off the steam at different periods of the stroke. This is accomplished by carrying the valve eccentric not directly on the shaft, but on a sleeve which can be shifted in position on the shaft, so as to change the angle of lead of this eccentric from a position in which the eccentric axis is nearly parallel to the direction of the crank to one in which it is nearly at right angles to it. According to the degree of this angle of lead so will the steam be cut off almost at the beginning of the stroke, or at a point rather less than three-quarters of the stroke. The work done by the steam pressure can therefore be varied within wide limits. The shift of the sleeve carrying the eccentric is effected by a set of jointed rods, which are moved by a pair of heavy weights carried on the end of levers, which are carried round with the shaft either in the flywheel or in a special governor wheel. The outward movement of these weights, caused by the centrifugal action, is resisted by powerful springs in the governor wheel, and any change of speed operates directly to shift the lead of the valve. In these last dynamos, No. 5 and No. 6, the cores of the field-magnets, as well as the armature cores, are built up of laminated iron, as described in § 3. The bobbins of the field-magnets are formed of rectangular split zinc frames, about 15 inches high and 20 inches wide. They are wound over with the insulated wire, but more wire is placed at the bottom of the frame than at the top, and the finished bobbins have a slight taper from about 8 inches to 6½ inches in end width. The armature bobbins are shallow rectangular bobbins, wound on vulcanized fibre frames about 19 inches long and 10 inches wide and two inches deep. Each bobbin has on it about 30 turns of highly insulated copper wire, about six millimeters or one-quarter inch in diameter. The armature coils when slipped on to the laminated iron cores are kept

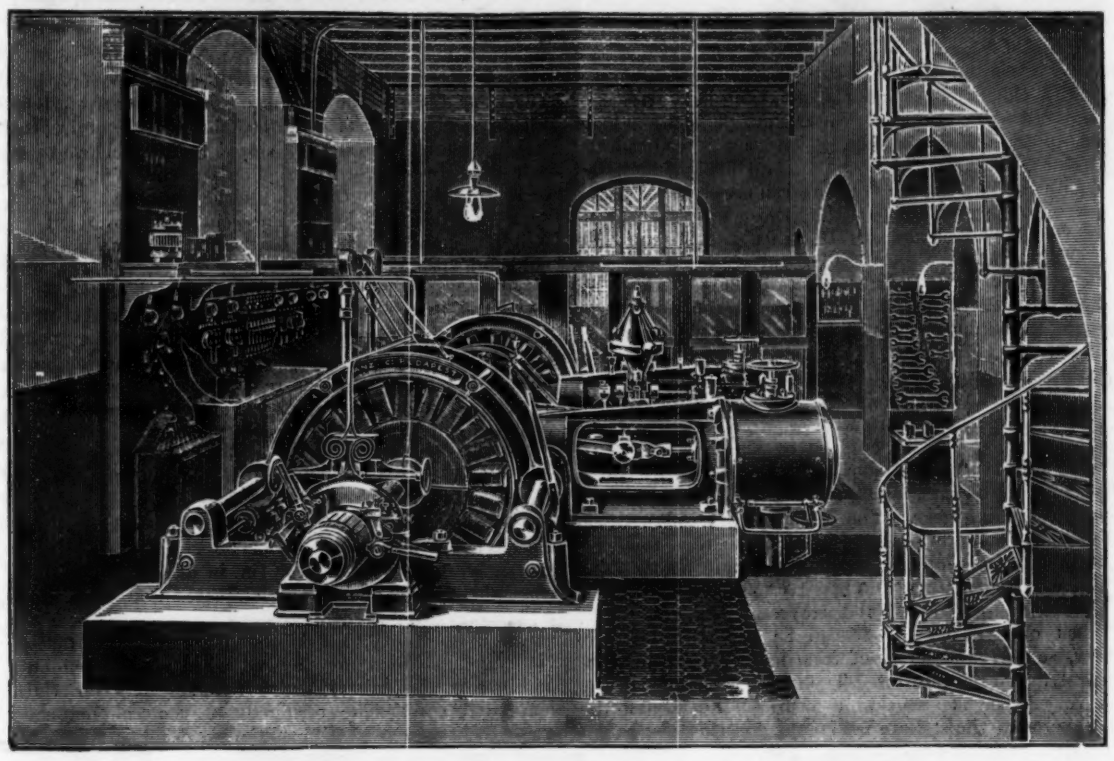


FIG. 19.—SMALL ALTERNATORS (80 KILOWATT) AT ROME.

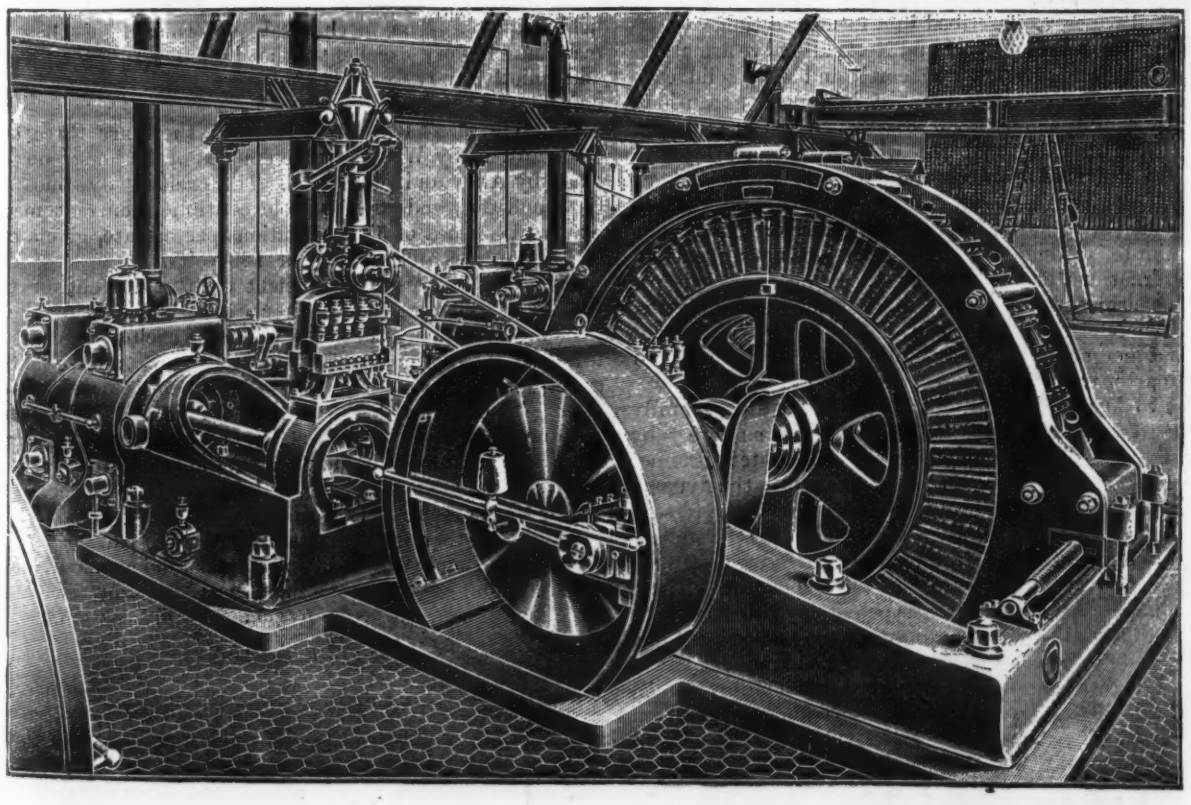


FIG. 20.—500 H. P. COMPOUND ENGINE AND ALTERNATOR IN THE CENTRAL STATION, ROME.

in position by bobbin holders of bronze, which form a kind of skeleton frame clamped on the end. The more massive electro-magnet bobbins are secured by a similar bobbin holder, and by a bolt fastening it which traverses the whole width of the laminated core. The terminals of the field-magnet circuit are led to two insulated brass pulleys deeply grooved, which are secured on the shaft. Over these are slung flexible copper stranded cables, one end of which carries a pendant weight, and the other end of which is in connection with the excitor circuit. This affords an excellent, and yet perfectly flexible, contact surface, for the excitor current to enter and leave the alternator field magnets. The mechanical performance of these latest machines is very excellent; the dynamos run very smoothly and quietly, and give no trouble by any heating or insulation defects.

To excite these four large dynamos, there are three exciters driven direct by Westinghouse engines of 50 h. p. each, made by Alley and Maclellan. The exciting dynamos are by Ganz and Company, and are four-pole continuous current machines, which, at a speed of 375 revolutions per minute, give a current of 150 ampères and pressure of 180 volts.

Since 75 ampères is a sufficient exciting current for each of the large dynamos, one excitor can excite two of the large dynamos, and hence there is always one excitor in reserve. At full load the power absorbed in exciting is said to be 3½ per cent. of total absorbed power. The steam is provided from a plant of fourteen Babcock and Wilcox tubular boilers, each of 160 nominal horse-power. Coke is burnt in the furnaces. Four steam pumps, in addition to the usual injectors, supply water to the boilers. The total boiler horse-power is 2,240. The steam pressure is 120 lbs.

There are, therefore, in this station three pairs of machines, each pair consisting of two similar independently driven dynamos, but all yielding a current at the same electro motive force, and having the same frequency of alternation.

(To be Continued.)

Mr. Edison on the Kemmler Execution.

Mr. T. A. Edison, when interviewed, said: In December, 1887, I wrote to a man who asked for my views that I would join heartily in a movement to abolish capital punishment. If it was not to be abolished, however, I said, we should adopt the quickest and least painful method of accomplishing it, and I believed an intermittent dynamo current properly applied would best meet these requirements. I still believe this. In the Kemmler execution, according to the reports printed in the newspapers, the fault rests upon the doctors. They acted upon theory, and knowing the base of the skull to be the nerve centre of the human system they determined to reach it as directly as possible. Theoretically they were right, but practically they were wrong, as experience has demonstrated. In not a single one of the 30 perfect examples of the power of electricity to produce instant death that have occurred in and around New York was it applied to the head. Of what use has the death of these 30 men been? In every instance the fatal charge entered through the hands. In no case among these accidental deaths was the current that passed through the body one-half what it was announced was to be used on Kemmler. Electricity travels through fluids, and especially through the saline fluids of the body, much more freely than through bone. The hands, when cleansed and immersed in a solution of caustic soda, afford an excellent contact for electric currents, and as the fingers, hands and arms are full of blood they make a good conductor of electricity. On the other hand, bone is one of the poorest conductors, and by making the points of contact on the thickest part of the skull and the portion of the spine affording most resistance the doctors invited a degree of failure. Neither contact could have been made in a less desirable place. The hair of the head is also a non-conductor and offers resistance to electrical currents. If, as is stated, Kemmler's skin was burned at the points of contact, that proves that he received but a small portion of the charge. Had he received the full 1,300-volt current for the length of time stated he would have been carbonized or mummified. If the report that 20 incandescent lamps were in the circuit and illuminated at the time the current was applied to Kemmler is true the explanation is in part at least furnished. These lamps offer resistance to the flow of the current, and 20 of them would greatly reduce the potential of the current. They should have been removed from the circuit.

"How do you account for the muscular and apparently respiratory action after the current had been once turned on?" was asked. "Oh, I have no doubt he was dead," replied Mr. Edison. "I think the doctors will probably agree to that. You know there is often muscular movement after death by hanging. Kemmler was undoubtedly killed at the first unless some big mistake was made. Undoubtedly all those present were greatly excited. I should have been excited myself at such a time. In that excitement there may have been some bungling. I think, when the next man is placed in the chair to suffer the death penalty, that death will be accomplished instantly and without the scene at Auburn."

A Westinghouse View of the Execution.

Mr. Paul D. Cravath, counsel for the Westinghouse Company, said that, judging from the reports published, he must believe that the Kemmler execution had not been successful. This was to have been expected by those who had taken pains to look carefully into the subject. Too many elements of uncertainty were involved to insure the purpose of the law in this matter. A hangman was reasonably certain of making sure of his work, because the conditions to be met by him in his business were apparent and readily to be comprehended either from a scientific or mechanical standpoint. In the use of electricity, those who employed it were obliged to rely upon a dynamo generating a force that they could not fully understand or control. From this dynamo proceeded two wires, which were supposed to carry a death-dealing current of electricity. The means of testing the strength of this current were not always reliable, because they consisted of very delicate machinery, which was easily put out of order. Therefore, it was impossible for the operators of a dynamo to know precisely what effect the electric current thus generated and transmitted might produce upon an object coming in contact with it.

A Conical Lamp Shade.

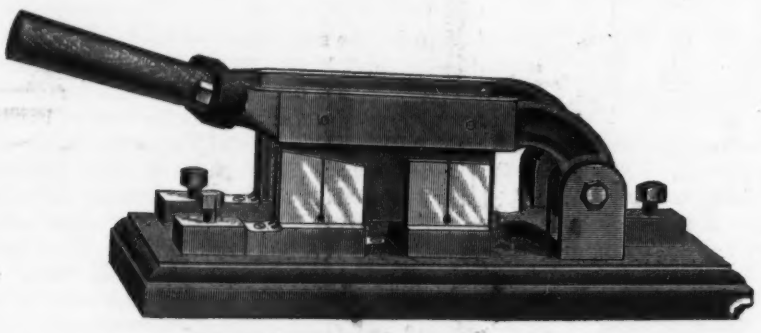
Tin shades being cheap and unbreakable, there has always been a demand for them from factories, mills, stores and other places where porcelain shades would prove too costly. A year ago Mr. Geo. Cutter, now manager of the Great Western Electric Supply Company, of Chicago, went a step farther and designed a tin shade which required no holder. The popularity of this "Combination Tin Shade," of which it is said 20,000 are in use, has now led the

CUTTER TIN LAMP SHADE.

same firm to bring out a new pattern called "Cutter's Combination Cone Shade." As the cut shows, it is of a deep cone shape, making it well fitted for the use of bookkeepers, draftsmen, engravers and others who want the light concentrated on their work. It fits the Thomson-Houston, Westinghouse and Sawyer-Man sockets directly, and hangs square at all times. Its convenience, together with its cheapness, will probably cause it to be widely used for desk and other similar lights.

A Central Station Switch for 3,000 Amperes.

Hundreds of the so-called "Andrews" central station switches, in capacities of 100, 250, 400, 600 and 1,000 ampères each, have been made by J. Lang & Company, of Chicago. The accompanying illustration shows one of much larger capacity than any they have heretofore made. From the design adopted it takes no more space lengthwise on the switchboard than either their 600 or 1,000 ampère switches. All the material from which these switches are made is the best obtainable, for durability and conductivity, and the workmanship is first class in every respect. A larger switch of this well known type will certainly be welcomed by those who have been familiar with the smaller sizes now in such general use.



LANG SWITCH FOR 3,000 AMPERES.

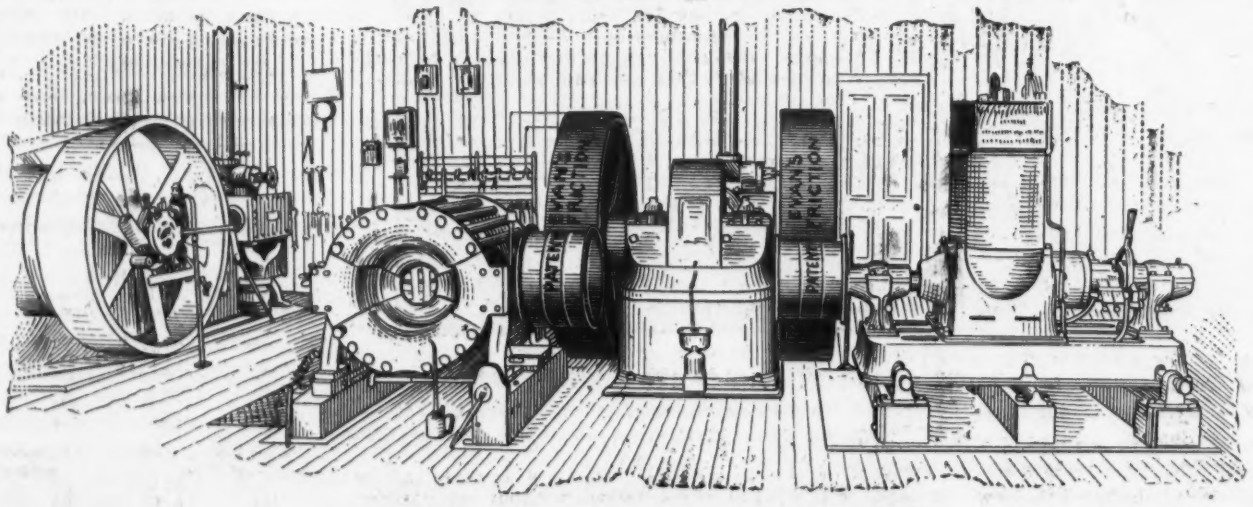
Another Excellent Friction Cone Plant.

We give on this page an illustration of the plant put in by the Evans Friction Cone Company, of Boston, Mass., at Hutchinson, Kansas. Again we see the compactness of this method of transmitting power.

The dynamo at the left is a Thomson-Houston "M. D." dynamo with a capacity of 50 full arc lamps, and the machine is fully loaded. The Edison machine is a number 16, 720 incandescent lamps. Both are driven from the fly-wheel of an Armington & Sims engine. This plant has been running constantly since January, 1890, and is giving entire satisfaction in every respect.

As we noted a fortnight ago, the same company is also fitting the whole of the machinery plant for the Leavenworth (Kan.) Electric Light Company. Two Ball engines, coupled to two 18-foot lengths of shafting, driving five Thomson-Houston arc dynamos, and three 70-h. p. Heisler incandescents, are some of the principal features of that station. The plant has been especially designed for the use of the Evans apparatus, and will have one of the finest lines of shafting in the United States.

The Evans cone thus seems to be making as rapid strides in popular favor at the West as it is in the East. Of its advantages in electric light machinery we have frequently spoken, and we are glad to note, from time to time, its adoption in new plants.



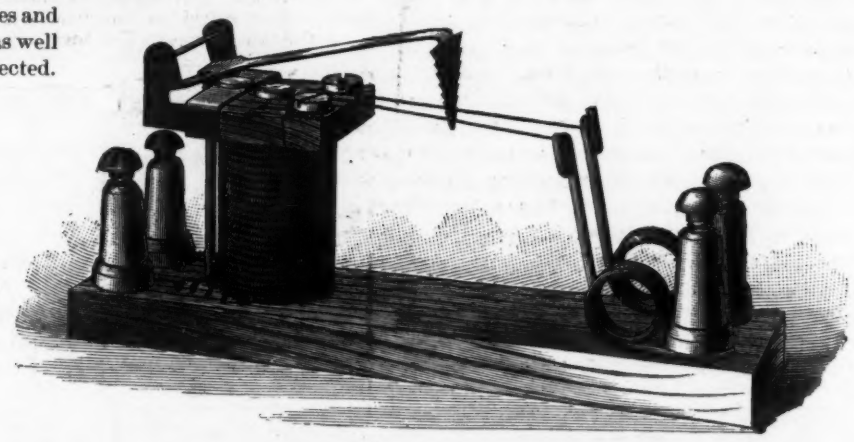
FRICTION CONES AT HUTCHINSON, KANSAS.

The Maxwell Current Protector.

The accompanying cut is an illustration of a lightning-arrester and strong current protector that appears to possess many valuable features. It has been patented by G. S. Maxwell, electrician for the Ohio Valley Telephone Company, at Louisville, Ky.

The advantages claimed for it as compared with other arresters are: First—On metallic circuits or loop lines one arrester does the work of two. Second—The same amount of resistance is introduced into both sides of the circuit. Third—The retardation of but one electro-magnet is introduced. Fourth—It uses no fuse, foil or high resistance wire, the connecting wires being of greater conductivity than those used in telephone instruments or telegraph relays. The opening of the circuit at the connecting wire is accomplished by the intensity of the arc formed at the contact between the crosshead of the armature and the connecting wires. Fifth—It protects the instrument, even though the ground wire to the armature should break, as the crosshead of the armature connects the connecting wire on the line side of the instrument with the corresponding connecting wire on the ground side of it. Sixth—The connections being under the strain of the tension springs (which form part of the circuit), there can be no loose connections in the instrument. Seventh—Long distance between the outside and inside circuits and no danger of arcs being formed when the circuit is broken. Eighth—It uses the dangerous current to open both sides of the circuit and stop the flow of the current. Ninth—Wide range of adjustment, arresters being made adjustable from one-eighth ampère at 50 volts to five ampères at 110 volts.

Whenever the outside circuit becomes crossed with a wire carrying a dangerous current the electro-magnet of the arrester is energized and the armature is drawn toward it, thus bringing the toothed cross head of the armature into contact with the connecting wires and short-circuiting the arrester as well as the instrument to be protected.



THE MAXWELL CURRENT PROTECTOR.

If the current coming in on the line is of considerable power the connecting wires are at once broken and the circuit completely opened. If, however, the current is of gradually increasing strength (what is called a "sneak current") whenever it rises to a dangerous degree the armature is attracted to the electro-magnet, the cross head is drawn against the connecting wires and is held against them by the teeth on its edges. This short circuits the arrester and the instrument to be protected, and as long as the current does not increase there is no farther change in their positions. But should the current increase, the excess of current shunted through the arrester will again energize it and draw the armature farther down, allowing the connecting wires to slip past the teeth they are engaged with. The result of this is to form an arc at the points of contact of sufficient intensity to fuse the connecting wires and open the circuit. All that it is necessary to replace in the arrester are the connecting wires.

The Maxwell protector and lightning arrester has proved a success wherever tried, and has been adopted by several prominent telephone companies as the best adapted to meet the requirements of a safe and effective instrument for the protection of central office apparatus, as well as to prevent damage to the instruments of individual subscribers.

A Switch for Incandescent Circuits.

Simplicity of construction, efficiency in operation and cheapness are among the main points which are looked for in any good article. These three points seem to be combined in the new "Convention" incandescent double pole switch, which we illustrate herewith and which is manufactured by the Illinois Electrical Material Company, Chicago.

"CONVENTION" SWITCH.

The perspective view shows the contact bar resting on the insulated ratchets. To form the circuit it is only necessary to turn the handle to the right and the bar will take a horizontal position on the brushes fixed on both sides, while a second turn gives an instantaneous break, the bar being thrown by the force of the spring about 3-16th of an inch. The ratchets are made of insulating material, as is also the block supporting the contact bars. A small slot cut sideways in the centre block aids in throwing the contact bar of the ratchet the necessary distance. To convert it into a single pole switch it is only necessary to remove the outer contact brushes.

Amenities of African Telegraphy.

The following extract from a letter recently received in England from an officer of the West African Telegraph Company gives a somewhat adequate idea of the pleasures and attractions that await the telegrapher who is lured to regions barbaric:

KOTONOU STATION,
May 1st, 1890.

. . . Our friend, the King of Dahomey, is, I am glad to say, about to receive a well-merited lesson. Last year, when I was in London, and told you something about the little games of these gentry, I thought the day could not be far distant when all that they had inflicted on us and the rest of the world would be repaid with interest. Last December I asked the company to supply us with arms, as the blood of "Messieurs les Dahomiens" was visibly warming, a phenomenon by no means surprising, considering our proximity to the sun. But what gives me particular pleasure to relate is that His Majesty Bedazin "Osu Bowélé," which, being interpreted, means "King Shark," who swore he would paddle his own canoe in our blood, failed to keep his word, and I have no hesitation in saying that I prefer working for the W. A. T. to serving as a burnt offering to my friend Bedazin. We had our turn on the 4th of March. The station was surrounded by the natives, and we were under the painful necessity of sending a few of them across the Styx. Seriously speaking, however, the station was for a time in imminent

danger; Orsini and I fired more than 250 rounds each; and the 35 Senegalese sharpshooters who helped in the defence, fired some 120 rounds apiece. An artillery sergeant, who worked our two guns, was killed, and the white gunners were so hard pressed that they had to club their rifles. This racket began at four in the morning. At 9 A. M. we left the soldiers still firing and went to the instruments, and you may imagine what a dance the mirror led us. By 10 o'clock, however, all was quiet in our neighborhood, and the messages had all been sent through . . I must not forget to tell you that we had to do with the famous Amazons. They were very fine creatures, fought like wild beasts, and were worth 10 men.

Death of Mr. J. H. Wade.

Mr. Jephtha H. Wade, one of the best known and most prominent pioneer telegraphers of America, died at his residence in Cleveland on Saturday, August 9. About the year 1848, in connection with Mr. J. J. Speer, jr., he built part of the old "Erie and Michigan" telegraph line from Detroit to Jackson. At that time the pay of telegraphers was not what would be considered in these days very high. Mr. A. B. Cornell was manager of the Cleveland office of this company at a salary of $400 a year, and on June 27, 1848, Mr. Wade was sent to Milan, Mich., at a salary of $400 per annum for himself and boy. He afterward built the "Wade" line from Cincinnati to Cleveland.

In 1855 the Erie & Michigan Company and the New York & Mississippi Valley Printing Telegraph Company were united under the name of the Western Union Telegraph Company, with a capital of $500,000. This was the origin of the gigantic corporation which has maintained almost absolute control of the telegraph business in this country ever since. Mr. Wade, then in the prime of life, able, shrewd, ingenious and energetic, was appointed the active agent of the consolidated company, and he chose Gen. Anson Stager as his lieutenant.

When, in 1861, the Pacific Telegraph Company was incorporated, principally by directors of the Western Union, Mr. Wade was made President. In 1864 the company was merged into the Western Union, and in 1866 Mr. Wade was unanimously elected President of the latter company, succeeding Mr. Hiram Sibley, whose failing health compelled him to go to Europe. To Mr. Wade's great executive ability is due the marked development and growth of the Western Union at this time. Mr. Wade remained President of the Western Union until after the absorption of the United States and American Telegraph Companies; but in 1867, on account of ill health he declined a re-election, and Mr. Wm. Orton was chosen his successor. Mr. Wade had made a vast fortune out of the telegraph. To be free from business cares, he sold out his entire telegraphic interests and for a time retired from active pursuits. With restoration to health, however, he became president and director in several banking, railroad and manufacturing enterprises in Cleveland, and at his death was one of the most prominent men of that city. Mr. Wade was born in Seneca Co., N. Y., August 11, 1811, and was therefore 79 years of age.

Pay Station Telephones.

A trial of the new automatic recording telephone system is to be had in Brooklyn, N. Y., by the New York and New Jersey Telephone Company. The new device, which is simply on the drop-a-nickel-in-the-slot plan, is to be adopted at pay stations. When a person wishes to telephone at a distance, on ringing up central from the pay station he will be told to place the proper amount in the slot. He will not be connected with the office he wishes to telephone to until he does so.

Important Changes in the Edison Company.

The Edison General Electric Company has issued a circular informing its patrons and others that the business of the United Edison Manufacturing Company and the Sprague Electric Railway and Motor Company have been transferred to the Edison General Electric Company, and that the business heretofore conducted by the two former companies will hereafter be conducted by the Edison General Electric Company, which will have district offices at New York, Chicago, Denver, San Francisco, Portland, Toronto and New Orleans. These will supply the territory as indicated below: *Eastern District*—Chas. D. Shain, manager, 16 Broad street, New York city; Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia and West Virginia. *Central District*—John I. Beggs, manager, Rialto Building, Chicago, Ill.; North Dakota, South Dakota, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, Ohio, and Kentucky. *Rocky Mountain District.*—Geo. W. Coster, manager, Masonic Building, cor. Sixteenth and Welton streets, Denver, Colo.; Kansas, Nebraska, Colorado, Wyoming, Montana, Utah and New Mexico. *Pacific Coast District.*—W. S. Heger, manager, San Francisco, Cal.; California, Nevada and Arizona. *Pacific Northwest District.*—S. Z. Mitchell, manager, Portland, Ore.; Oregon, Washington and Idaho. *Southern District.*—O. T. Crosby, manager, Cotton Exchange Building, New Orleans, La.; Texas, Arkansas, Indian Territory, Louisiana, Mississippi, Tennessee, Alabama, North Carolina, South Carolina, Georgia and Florida. *Canadian District.*—M. D. Barr, manager, Bank of Commerce Building, Toronto, Ont.; British Columbia, Northwest Territory (Athabasca Alberta, Assinoba and Saskatchewan), Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Northeast Territory, Labrador, Newfoundland. F. S. Hastings has been elected treasurer of the company and A. Beves assistant treasurer.

New Central Station.

Work has been commenced on the power house of the Milwaukee Light & Power Company, at Milwaukee, Wis. The building is to be 40 × 128 feet, with an engine room 40 × 65, a boiler room 40 × 60, a dynamo room 40 × 125, and a storage room 40 × 80. It will have three stories and be of stone and brick, and will be completed by Nov. 1. The building will cost about $20,000, and will have a 1,000 h. p. engine. The company will furnish incandescent and street lighting. The officers of the company are W. H. Earles, president; Oscar Altpeter, Secretary, and John J. Kempf, treasurer. The Westinghouse system will be used. The new building will be situated on Commerce street, near the foot of Galena street.

The Working Efficiency of Secondary Cells.*

BY W. E. AYRTON, C. G. LAMB, F. W. SMITH, AND M. W. WOODS, ASSOCIATES.

II.—EFFICIENCY.

In the earlier of the experiments made by us on the efficiency, two distinct groups, each of 10 cells, were employed. The current passing through the two sets of cells also passed through two platinoid strips, and the P. D. at the terminals of each of these platinoid strips was measured by a suitable low-resistance galvanometer, whose indications, therefore, measured the respective currents passing through the two sets of cells. The P. D. at the terminals of either group of cells was measured by means of a high-resistance D'Arsonval galvanometer, which, by means of a switch, could be connected with the terminals of either of the two groups. The high-resistance and one of the low-

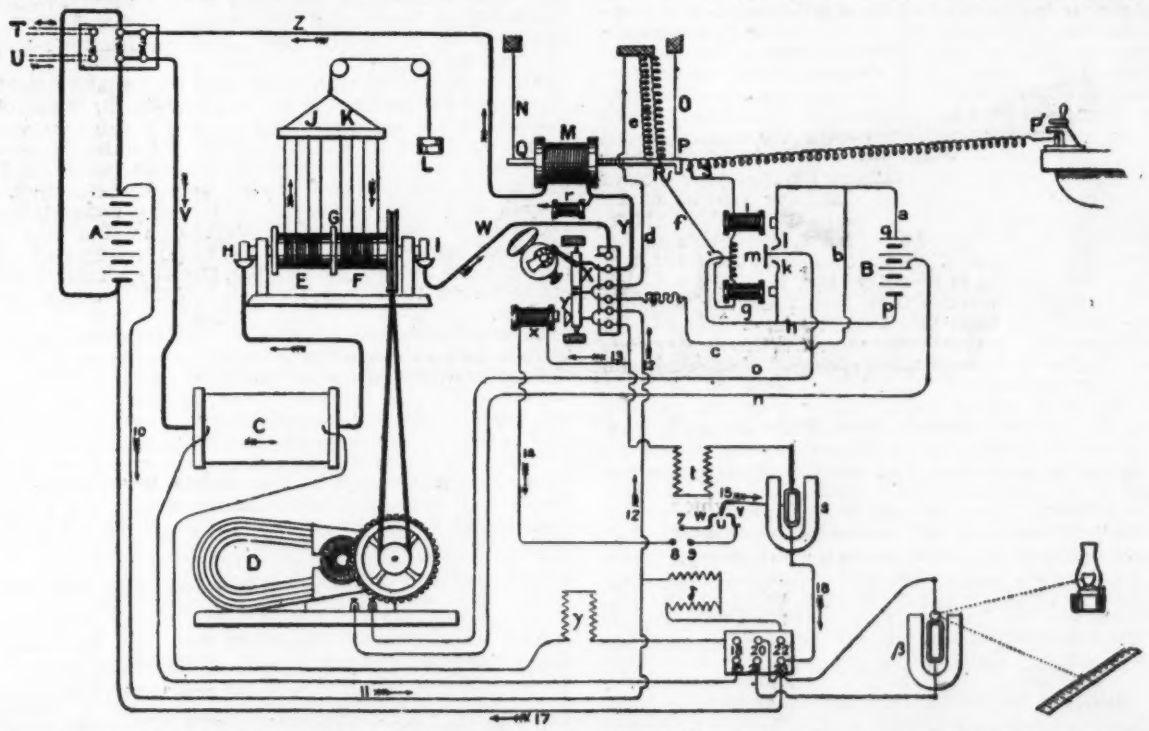


FIG. 5.—AUTOMATIC CURRENT REGULATOR AND INTERRUPTOR FOR BREAKING THE CIRCUITS.

resistance instruments have been absolutely calibrated very frequently during the past few years by means of the silver voltameter, known resistances, and Latimer Clark standard cells. A special calibration was also taken of these instruments, both just before these experiments were commenced and at their conclusion.

Group I. of 10 cells was first charged with 9.05 ampères and discharged with 9 933 ampères, there being four discharges, alternated with four charges, without intermission, from Jan. 8 to Jan. 12, 1889, both days inclusive. One of the observers was always present (day and night) to keep the current constant by hand regulation, to take frequent readings of the P. D. at the terminals of the set of 10 cells, to stop the charging when the P. D. per cell reached 2.4 volts and immediately start the discharging as well as to stop the discharging when the P. D. per cell reached 1.6 volts and instantly start the charging again, so that the cells were never left discharged.

We used the limits 2.4 and 1.6 volts per cell as the criterions for stopping respectively the charge and discharge, since, as already seen, the slope of the charge and of the discharge curves are greatest for about these values of the P. D.

Next, Group I. was charged with 4.519 ampères and discharged with 9.933 ampères, twice. without intermission, from Jan. 14 to Jan. 19, inclusive, the P. D. limit for charge being 2.4 volts, and for discharge 1.5.

And while the two sets of tests were being made with Group I., Group II. was first charged with 9.104 ampères and discharged with 4.858, twice, without intermission, from Jan. 9 to Jan. 12. And, lastly, Group II. was charged with 4.519 ampères and discharged with 4.858, without intermission, from Jan. 14 to Jan. 19, both days inclusive.

Shortly, then, the tests were:

	Charge.	Discharge.
Group I.	9	10 ampères.
	4½	10 "
Group II.	9	5 "
	4½	5 "

The coarse adjustment of the resistance for keeping the current constant was effected by means of resistance coils made of bare German silver wire suitable for standing large currents; the fine adjustment was performed by means of horizontal mercury troughs through which the current passed, the lengths of the mercury in the wooden troughs through which the current passed being varied by copper bridge pieces. This mercury trough arrangement forms an extremely convenient resistance for delicate adjustment by hand. To keep the current as constant as possible a dynamo was not used to charge the accumulators under test, but they were charged instead from other accumulators of much greater storage capacity.

The general expression for the ampère-hours and watt-hours given out by an accumulator are, of course,

$$\int_o^{t_1} A_1\,dt, \text{ and } \int_o^{t_1} V_1 A_1\,dt,$$

where A_1 and V_1 are the current in ampères passing through the accumulator, and the P. D. at its terminals at any moment, and t_1 is the time in hours during which the discharge lasts. Consequently, if A_2, V_2, and t_2 have similar meanings for the charge, the complete expressions for the quantity and energy efficiency are, respectively,

$$\int_o^{t_1} A_1\,dt \div \int_o^{t_2} A_2\,dt,$$

and

$$\int_o^{t_1} V_1 A_1\,dt \div \int_o^{t_2} V_2 A_2\,dt.$$

In our experiments A_1 has a constant value during the discharge, and A_2 a constant value during the charge, so that the expressions for the quantity and energy efficiency reduce themselves to

$$\frac{A_1 t_1}{A_2 t_2},$$ which is very easy to calculate, and $$A_1 \int_o^{t_1} V_1\,dt \div A_2 \int_o^{t_2} V_2\,dt$$

To obtain $\int_o^{t_1} V_1\,dt$ a time curve of the values of V_1 is drawn and integrated; similarly, to obtain $\int_o^{t_2} V_2\,dt$ a time curve is drawn for V_2 and integrated; then, multiplying the first integral by the steady value of the discharge current A_1, and the second integral by the steady value of the charge current A_2, we have, respectively, the watt-hours given out in the discharge and the watt-hours put into the accumulators in the charge.

After drawing a series of time curves for the P.D. in the various experiments already referred to, and integrating them with an Amsler's integrator, we obtained the following results for the successive charges and discharges.

GROUP OF 10 CELLS—NO. I.

Discharge at 9.933 ampères.		Charge at 9.05 ampères.		Percentage.	
Ampère-hours.	Watt-hours.	Ampère-hours.	Watt-hours.	Quantity efficiency.	Energy efficiency.
119	2,280	114	2,435	105	94
105	2,045	102	2,220	103	92
101	1,970	101	2,220	100	87
104	2,020	104	2,270	100	89
Discharge at 9.933 ampères.		Charge at 4.519 ampères.			
112.5	2,170	115	2,485	98	87
113	2,190	115	2,485	98	88

GROUP OF 10 CELLS NO. II.

Discharge at 4.858 amperès.		Charge at 9.104 ampères.		Percentage.	
Ampère-hours.	Watt-hours.	Ampère-hours.	Watt-hours.	Quantity efficiency.	Energy efficiency.
154.5	3,005	138.5	2,910	111.5	103
141.5	2,770	129.7	2,820	109	98
Discharge at 4.858 amperès.		Charge at 4.519 ampères.			
143	2,785	141	3,075	102	90.5

* Continued from THE ELECTRICAL WORLD, Aug. 9, 1890.

Now not only are quantity efficiencies of 105, 103, 111, 109, etc., per cent. impossible, but energy efficiencies of 94, 92 per cent. are also too high, when accumulators are being charged and discharged at the maximum rate allowed by the manufacturers. Further, it is noticeable that for each set of tests both the quantity and energy efficiencies diminish on the whole as the tests proceed. These cells, like the other cells in the Central Institution laboratories, have been charged at regular times; and as the number of ampère hours taken out of them for ordinary laboratory work varies very much, the intervals between the periodic chargings are so arranged that on the whole the cells are charged up much more than they are discharged.

Hence, at the commencement of these tests the cells had a large store of energy in them on which to draw in the discharges, the results of which are given in the preceding table. From this we learn this very important fact—that if accumulators be thoroughly well charged up before being tested, then five days' continuous charging and discharging alternately with even the maximum currents allowed by the manufacturers fails to give the normal quantity or energy efficiency.

It will be noticed that both the ampère-hours and the watt-hours are increased by diminishing the current employed. This is partly due to the fact that if a fixed P. D. limit per cell be employed either in discharging or charging, the cell is discharged until the E. M. F. is slightly lower, and charged until the E. M. F. is slightly higher for a small current than for a larger one.

III.—AUTOMATIC CURRENT REGULATOR.

We think it possible that a neglect of the power that accumulators possess of drawing on a store of energy put into them in former chargings may have led experimenters to conclude that the normal efficiency of certain types of accumulators was greater than was really the case. To ascertain the *working efficiency* of the accumulators we were testing, it was clear that they would have to be charged and discharged alternately with a definite charging and a definite discharging current continuously for a much longer period than five days. And as this would be a very laborious operation if the current had to be kept constant day and night during this period by hand regulation, we proceeded to construct the automatic current-regulating device shown in Fig. 5.

A is a set of five accumulators under test, where *B* is a totally independent set of four used to provide the power for working the current regulator. *C* is a platinoid strip of sufficiently large cross section and surface that no appreciable change of resistance can take place by the largest current—ten ampères—that flows through it in these experiments. *D* is a permanent magnet motor, the rotation of which in either direction turns the brass roller, *E F*, very slowly in one direction or the other, the pinion and toothed wheel of the motor, combined with the small grooved pulley on the toothed wheel shaft and the much larger grooved pulley on the roller, causing the angular motion of the roller to be about $\frac{1}{600}$th of the angular velocity of the armature of the permanent magnet motor. The brass roller, *E F* is electrically divided into two halves by the ebonite disc *G*, and little amalgamated discs at the ends of this roller turn with but little friction in mercury cups, *H, I*. Round each half of the roller are wound four bare platinoid wires of No. 26 gauge, and each about 4½ feet long. Their lower ends are soldered to the brass roller, and their upper ends to the brass bar *J K*, small spiral springs (not shown in the figure) being introduced to keep the wires taut. The rod *J K* is held up by a cord which passes over two pulleys, and to the end of which is attached the weight *L*. An electric current entering at *H* follows the path *H, E, J, K, F, I*, the path being longer or shorter depending on the amount of the platinoid wires wound on the two halves of the brass roller. *M* is a solenoid, being, in fact, the coil of an A. and P. ammeter, on the axis of which a rod, *P Q*, was very delicately poised by its being supported by four very fine wires of No. 40 gauge, and each about 1 foot long. Two of the wires, *N*, on a plane at right angles to the path, joined together where they were connected with the rod at *Q*, but spread out at the top, and similarly *O* consisted of two wires. Thus, while the rod *PQ* had great freedom of motion along its axis, it could not wobble sideways. This rod consisted of two pieces of brass at its ends, but the middle shaded portion was the well-annealed soft iron tubular core of the ammeter. A current passing round the coil *M* sucked in the core more or less against the pull of the antagonistic spiral spring *P P'*. This spring was made of platinoid wire of No. 26 gauge, wound round a ¼-in. mandril, and when pulled out in position it had about 30 turns to the foot, and was over four feet in length. One end of the spring was attached to the rod at *P*, while the other, *P'*, was fastened to a fine thread, which could be wound up more or less round a smaller roller and the tension of the spring very delicately adjusted.

At first the elasticity of this spring was not perfectly constant, but after about one month's use the pull it exerted when stretched to a given length became wonderfully definite, and the core *P Q* could be adjusted so that for a current of exactly 9 ampères flowing round the solenoid *M* the projection at *P* remained midway between the contacts *R* and *S* without touching either. But on the current flowing round the solenoid *M* becoming very slightly greater, or very slightly less than 9 ampères, the platinized projection of the rod at *P* made contact with either the platinized piece *R* or *S*. The permanency that the spring eventually attained was so great that even when the apparatus had not been in use for two or three weeks one had only to close the circuits to start the regulator, and no fresh adjustment whatever of this spring was necessary to ensure that the current would be kept absolutely constant at 9 ampères. This spring has, however, now gone the way of most bare fine platinoid wire, of breaking up into pieces.

When the cells *A* under test were being charged by means of a set of accumulators not shown on the figure, but attached to the leads *T* and *U*, three copper bridge-pieces were put in to connect the mercury cups 4 to 5, 2 to 6, and 1 to 3, respectively; whereas when the test cells were being discharged two copper bridge-pieces connected the mercury cups 2 to 3 and 5 to 6. The current passed, of course, one way through the cells *A* in charging and the other way in discharging; but in both cases a positive current flowed, as indicated by the arrows, through the thick lead *V*, the platinized strip *C*, through *H, E, J, K, F, I*, through the thick lead *W*, the thick lead *Y*, the solenoid *M*, and the thick lead *Z*. As already explained, if the currents through this circuit exceeded in the very least 9 ampères, the core *P Q* was sucked into the solenoid *M* until *P* made contact with *R*; whereas if the current fell in the least below 9 ampères, *P Q* was pulled back by the spring *P P'* until *P* made contact with *S*. In the former case a small auxiliary current from the accumulators *B* follows the course *a, b, c, d*, through the spirals *e*—several in number, so as to carry the current, but made of extremely fine wire, so as to oppose practically no resistance to the free motion of *P Q*—then from *P* to *R*, through *f*, the electro-magnet *g*, and through *h*, back to the other pole of the battery *B*. If, instead, *P* be in contact with *S*, then the current from the auxiliary accumulators *B* passes from *P* to *S* through the relay electro-magnet *i*, instead of through the relay electro-magnet *g*. In the former case the spring tongue *k* is attracted so as to make contact with *M* (*M* being in reality a mercury cup into which dipped a platinum point with which *k* was tipped), and in the latter case the spring tongue *l* is attracted so as to make contact with *m*. If *k* makes contact with *m*, a positive current commencing from the middle of the accumulators *B* follows the path *n*, the motor, through *o, m, k*, and back to the end of the accumulators *p*; whereas if *l* makes contact with *m*, a positive current follows the path *q, a, l, m, o*, the motor, through *n*, and back to the middle of the cells *B*.

Accordingly, then, as *P* makes contact with *R* or with *S*, a current is sent one way or the other through the armature of the permanent magnet *D*, and the roller *E F* is turned around one way or the other so as to unwind, or wind up, more of the wire and automatically alter the resistance in the circuit. Although the whole apparatus was home-made, and looked very rough, it was able to automatically keep the current constant to 1 part in 600 for days at a time.

As the charge was effected with nine ampères and the discharge with ten, a shunt *r*, exactly nine times the resistance of *M*, was connected across *M* during the discharge, and as the automatic regulator kept the current through *M* constant at nine ampères, it kept the current through the circuit constant at ten when the shunt *r* was attached to *M*.

The necessity of using the relay electro-magnets *g* and *i* arose from the fact that the only suitable permanent magnet motor which was at our disposal was a laboratory hand magneto-Gramme machine which required a current of about 1 ampère to work it, and to obtain great sensibility the contacts between *P* and *R* or *P* and *S* had to be too slight to carry such a current.

It was very interesting to watch the regulator, since the armature of the motor was almost always in motion, now making half a turn one way, now one turn the other. It may be mentioned that one turn of the motor armature shortened or lengthened each of the platinoid wires by about the 62d of an inch—that is, by less than the 1-3000th of its whole length.

At first all sorts of plans were tried for keeping clean the surface of the mercury in the mercury cup *m;* but alcohol floated on the mercury failed because it dried up, water was electrolyzed, oil was carbonized, and a long conducting point adhered to each of the platinum points *l* and *k*, and the auxiliary accumulators *B* were short-circuited. In despair we left the surface of the mercury completely exposed to the air, and were surprised to find that that answered perfectly; a thickish layer of mercury and mercurous oxide formed on the top, but the platinum wires easily forced their way through, and always made good contact.

To avoid, however, all risk of accidents, cut-outs were introduced into various parts of the circuit; and to prevent the motor overwinding the platinoid resistance wires on the roller *E F* and breaking them, should the current in the main circuit accidentally become much too small, as well as to prevent the motor unwinding the wires too far off the roller should the current become much too large, safety keys (not shown in the figure) were provided. If the rod *J K* were drawn down dangerously low, or allowed to go up too far, it touched one or other of the safety keys and broke the electrical circuits.

IV.—AUTOMATIC INTERRUPTOR FOR BREAKING THE CHARGING AND DISCHARGING CIRCUITS.

As it was extremely important that both the charging and discharging circuits should be broken at the exact moment when the P. D. in its rapid variation passed through certain specific values, and as in a long course of experiments, lasting for several months, it was quite possible that occasionally no one of the observers would be present at the exact moment, we arranged an interruptor to break the circuit automatically when the P. D. in charging reached 2.4 volts per cell or 1.6 volts per cell in discharging. The automatic interruptor was arranged thus: *s* is a D'Arsonval galvanometer, the coil of which, wound with platinoid wire of 154 ohms resistance, is joined in series with a resistance box *t* as a shunt to the accumulators *A* under test. Electric connection was made with the bottom of the coil by means of a fine spiral string too thin to introduce any controlling moment, while above the coil was suspended by a phosphor-bronze strip $\frac{1}{1000}$ inch thick, $\frac{12}{1000}$ broad and 1¾ inches long. This strip had seven twists put into it by means of a head moving in a tight collar, the coil being prevented from turning by a pointer, *u*, attached to the framework of the coil coming into contact with the stop *v*. The thin phosphor-bronze strip being very thin, it had very little torsional rigidity, and being set up as described, this instrument acted as a "set-up voltmeter"—a type of instrument proposed some years ago by Professor Perry and one of the authors of the paper for measuring with great accuracy a very small change in a P. D. With a definite adjustment of the resistance in the box *t*, the platinum-tipped pointer *u* remains in contact with the stop *v* for all P. D.'s between the terminals of the accumulators *A* less than 2.4 volts per cell. When the P. D. reaches this value the pointer at once leaves the stop *v*, moves over through an appreciable distance, and makes contact with the platinum-tipped stop *w*. With another definite adjustment of the resistance in the box *t*, the pointer *u* remains in contact with *w* for all P. D.'s between the terminals of the accumulators *A* greater than 1.6 volts per cell, but the moment this value is reached the pointer moves away from *w* and makes contact with the platinum-tipped contact-stop *v*.

When charging, a copper bridge-piece connects the mercury cups 7 and 8, and when, on the P.D. at the terminals of the accumulators *A* reaching 2.4 volts per cell, the pointer *u* passes over and makes contact with *w*, an instantaneous small current is sent by the accumulators *A* through the electro-magnet *x*, which, attracting the armature *y* downwards, tilts the spindle *z*, and thereby lifts *X* and the other two contact-forks out of the three sets of mercury cups, thus breaking *all* the circuits. The tilting of the spindle *z* also brings a camel's-hair brush into contact with the balance of a watch, and stops it at the moment the charging is completed.*

In discharging the cells *A* mercury cup 7 is connected to 9 instead of to 8. During the discharge the pointer *u* rests against *w*, and on the terminal P.D. of the cells falling to 1.6 volts per cell the pointer moves over, comes into contact with *v*, and an instantaneous current passes round the electro-magnet, breaks all the circuits, and stops the watch. The course of this instantaneous current at the end of the charge and discharge is indicated by the arrows numbered consecutively 10, 11, 12, 13, 14, 15, 16 and 17.

To prevent any sluggishness in the action of this interruptor from a possible sticking of the pointer *u* against the contact-stops *v* or *w*, the pedestal supporting the set-up galvanometer *s* was kept in a constant state of slight vibration by the going of an American clock works that was placed on this pedestal.

V.—AMMETER AND VOLTMETER.

There remain only to be described the ammeter by means of which the current passing through the accumulators could be measured from time to time in order to see whether the automatic regulator was doing its duty, and the voltmeter for frequently measuring the P. D. at the terminals of the accumulators *A* under test. As the current had only to be very occasionally measured, one D'Arsonval galvanometer, *β*, was employed for both purposes. Its coil was wound with platinoid wire of 52 ohms resistance and suspended in the way that has been already described,† which enable the deflection from one end of the scale to the other to be absolutely proportional to the current. The top suspension was a phosphor-bronze strip $\frac{1}{1000}$ inch thick, $\frac{12}{1000}$ wide and about 1¾ inches long; while electric contact was maintained with the bottom of the coil by means of an extremely fine A. and P. spring, offering no appreciable torsional rigidity. The permanent magnets employed belonged to an old magneto machine, and into the cylindrical space between their poles, in which the Siemens armature formerly turned, was put a coil made of the right shape to suit the curved ends of the magnets without it being necessary to employ any soft-iron pole pieces. Experiment showed that deflection right across a scale 2 feet 9 inches long, the zero for no current being at one extreme end, was rigorously proportional to the current—a result which, as has been already pointed out, is very far from being obtained with D'Arsonval galvanometers as usually constructed.

When it was desired to measure the current passing through the accumulators *A*, a rocking switch was turned so as to connect mercury cup 18 to 20 and 19 to 21; whereas when it was the P. D. at the terminals of the accumulators that was to be measured, the rocking switch was turned so as to connect mercury cup 20 to 23 and 21 to 22. In the former case, with a resistance of 264 ohms on the resistance box *γ*, a current of 10 ampères passing through the cells and platinoid strip *C* produced a deflection of 500 scale divisions, or 50 divisions per ampère; while, with a resistance of 71,570 ohms in the resistance box *δ*, a P. D. of 10 volts at the terminals of the five accumulators *A* under test produced the same deflection; so that 50 divisions corresponded then with one volt.

(To be continued.)

*As it was undesirable to risk an expensive watch, we purchased one of the watches that could be then obtained in St. Paul's Churchyard for three shillings and fivepence halfpenny. This watch was very substantial, had a very strong hair-spring which could not be easily damaged, and was an excellent time-keeper—far superior to many watches of a far more expensive character.

†See paper on "Galvanometers," *Phil. Mag.*, July, 1890.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Aug. 11, 1890.

Mr. J. C. Hatzel, of the firm of Hatzel & Buehler, is spending a very pleasant vacation with his wife at Newport, R. I.

Mr. Scott Sims, of the Sims-Edison Torpedo firm, is building a torpedo boat to run at a speed of 18 miles an hour for the United States government. The test of it is to take place in the fall.

Mr. Thomas F. Nevins, chief engineer of the Fire Department and secretary and treasurer of the Citizens' Electric Illuminating Company, is thinking of leaving his post in the Fire Department to give his time wholly to private business. He will complete twenty years of service in November, and can then retire on half pay at $2,500 a year.

Dr. S. S. Wheeler, electrical expert of the Board of Electrical Control, sent a letter to Mayor Grant, of this city, last week in reference to the failure of the Fire Department to remove its wires and poles from the streets. Dr. Wheeler asserts that the wires can be buried by taking them into streets parallel with those upon which they are now stretched on poles.

Mr. James F. Kelly, general sales agent for the Edison-Lalande battery, has issued a very neat descriptive catalogue of these batteries. It is printed in colors, contains full and accurate descriptions of all the varieties of this cell, records and results of its tests and a statement of its advantages for various uses. Testimonials are given from those who have proved its value by using it.

A sample card of fuse wires, mounted upon a sheet of tin and accompanied by a calendar for 1890, has been arranged by the Consolidated Fruit Jar Company, of this city. It contains 10 samples of fuse wire neatly arranged, and around the edge of the sheet are placed decorative tiles upon which are shown the names of the various specialties which this company is offering to its customers.

To Build a New Street Railway.—The franchise for a street surface railroad in Brooklyn in Thirty-ninth street, Second avenue, Fifty-second street and Fifth avenue, to the New Utrecht line, granted to the South Brooklyn Railroad Company two years ago, is to be utilized by John W. Ambrose, of the Thirty-ninth Street Ferry Company and the South Brooklyn Terminal Company. He purchased the franchise at the sale by the city, and the work is likely to begin as soon as Second avenue is graded. Either electricity or a cable will be the motive power.

A New Firm of Electrical Engineers.—Messrs. Charles E. and Frank A. Pattison have organized the firm of Pattison Brothers, with offices at 135 and 137 Broadway, this city, to do estimate and contract work upon electrical and steam plants. Mr. Charles E Pattison has been associated with the engineering department of the Edison Company in this city for several years, and has been engaged in the work of construction on the Edison up town stations under the superintendence of Mr. Vail. Mr. Frank A. Pattison was formerly in charge of the Edison underground work at New Orleans, La.

The L. J. Wing Company, 80 John street, this city, has made a large number of important sales of its fans in the last two

months. Among the customers that appear on the company's order book are the Edison Illuminating Company, the Edison Electric Company, and the United Electric Light and Power Company of this city; the Western Electric Company and the Western Union Telegraph Company, of Chicago; the Light, Heat and Power Company of Plymouth, Pa.; the Electric Manufacturing Company, of Rockford, N. Y.; the Beardstown Electric Company, Beardstown, Ill.; and the United States Capitol at Washington.

Application Granted.—The State Railroad Commissioners have approved the application of the Coney Island and Brooklyn Railroad Company for permission to change its motive power from horses to electricity upon that portion of its road in Sea Breeze avenue, from East Fifth street to West Fifth street, on condition that the rate of speed of cars shall not exceed that to be determined by the Highway Commissioners of Gravesend, and that no car shall be operated with less than two men in charge. The road already operates by electricity under the consent of the local authorities, except across Ocean Parkway, where they use horse power by permission of the Brooklyn Park Department. The road was obliged to get the consent of the Railroad Commission to operate by electricity, since the law substituting that board for the local authorities as the body authorized to give consent for change of motive power has been declared constitutional by the Court of Appeals.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Aug. 9, 1890.

The Page Belting Company, at Concord, has recently erected another addition to its buildings.

Mr. G. L. Patterson, with Hazazer & Stanley, New York, favored us with a call this week. He reports a rushing business in his electrical house furnishing goods.

The Cohasset Electric Company, of Cohasset, Mass., has been incorporated with a capital of $30,000. Amos A. Lawrence is president, and Melville P. Morrell, treasurer.

Annual Clam Bake.—Invitations are now being sent out for the Annual Clam Bake given by the American Electrical Works, to the fraternity. It will take place Saturday August 23 at the Vue de l'eau Club.

Messrs. J. A. Grant & Co. have lately installed a complete 300 h. p. plant, using McIntosh & Seymour engines and boilers, in connection with the Thomson-Houston International Company's plant at Zacatecas, Mexico.

Insurance Inspectors.—The National Committee of Insurance Exchange Inspectors will meet at Cape May, Aug. 16, their object being to adopt uniform by-laws to govern electric insurance throughout the United States.

W. C. Woodward, formerly with the Standard Electric Company, of Vermont, and Wm. J. Fairbanks, a well-known financial man of Boston, have formed the Standard Supply Co., and will open offices at once at 180 Summer street, this city.

The Fitchburg Steam Engine Company, of Fitchburg, Mass., is putting in a large plant, engines, boilers, etc., for the Clinton (Mass.) Electric Light Company, and a complete plant for the Electric Light Company at Princeton, N. J.

Mr. Geo. Cutter, of the Great Western Electric Supply Company, Chicago, is in Boston for a few days. Mr. Cutter says a new comet has appeared in the horizon and on its tail the magic words "use Simplex wire," reflect the sentiments of a nation.

The Thomson Electric Welding Company is building large works at Newark, N. J., for the purpose of welding tubes to go into ice machines and similar machinery. E. P. Ball, of Palmer, Mass., is the engineer and has furnished all the plans for the new building.

Mr. C. W. Holtzer, of Holtzer-Cabot Electric Company, is at his office now every day, although he has not yet completely recovered from the injuries received in an accident some time ago. Mr Holtzer is a hard worker, and the trade throughout the country, where his friends are legion, will be glad to know that he is able to be at his desk again.

Lynn, Mass.—Work at the Thomson-Houston Electric Company's factory was never so rushed as at present. There are 38 men at work in the draughting room. In the motor department the running gear of 18 street cars has just been completed, and these are now being loaded on freight cars for shipment. These go to Wichita, Kan., Cincinnati, British Columbia and various points in Canada.

New Building.—The contract for the new factory L of the Thomson-Houston Electric Company was let out this week. Dearborn Bros. were given the contract for the mason work, and Frank G. Kelley the carpenter work. It is to be located on Federal street, and will be an extension of factory C. Its dimensions are 60 × 100, three story, with a basement. It is to be completed in four months, and will be used for general factory work.

The Pettingell-Andrews Company, in its usual wide-awake manner, has rented a large house on Boylston street, in this city, and is sending out invitations to its friends to view the G. A. R. parade on Tuesday next. The members of this enterprising firm say the column moves at 10 A. M. It is understood that the column on "K. W." cut-outs is moving continually, and although the charge is a severe one, still they have bravely held their own, and await further attacks of the same kind with perfect composure.

Reduced rates to Cape May.—Since our last issue arrangements have been made by the Rail and Sound lines to furnish excursion tickets from Boston to New York and return at the following rates: via all rail and return, same route, $7.50; going via all rail and return via Sound line or *vice versa*, $6 75; via Sound lines in both directions, $6.00. Tickets will be on sale Aug. 15th to 23rd inclusive, good to return until Aug. 27th inclusive, continous passage in either direction. This rate added to the low rate of $5.25 from New York to Cape May and return made by the Pennsylvania Railroad should insure a large attendance from New England.

Insurance Rule.—At the regular meeting of the New England Insurance Exchange, on Aug. 2, the following amendment in regard to defective electrical apparatus was adopted: "The electric Inspector of this Exchange shall report to its secretary such electrical apparatus as he finds is not installed in accordance with the rules of this Exchange. The secretary shall at once notify both the assured and the party installing the apparatus of all defects; and if at the expiration of 30 days from such notice he shall not have been duly notified that such defects have been remedied, the rate on both building and contents shall be advanced at least 10 cents, and the new rates duly promulgated by him."

Street Lights.—The city of Boston is now getting its street lights maintained for 40 cents a lamp per night instead of 65, the former price. It will be remembered that at the hearings last spring when the Suburban Company offered to light the streets for 40 cents a light per night, Mr. Burdett, counsel for the Boston Electric Light Company, made a formal offer on behalf of his company to do the work for the same price. Since May 1 of this year the Boston Electric Light Company has been doing the work at the reduced figures. There is no written contract, however, binding either the city or the electric light company. The city is now using 800 arc lights per night and numbers of new lights are being added constantly. This saving to the city will be used in the lamp department to give the city better lighting and many new lights will be placed in Roxbury, South Boston and the Dorchester district.

Chas. B. Raub, the electrical expert who has had charge of the construction of the Manet street railway, has probably had as varied a career as anyone in the service to-day. He assisted in building the first telephone exchange at New Haven, Conn., in the early days of the telephone, and afterwards traveled over the United States erecting territorial lines. About this time the electric light field became active, and Mr. Raub entered the service of the United States Company, and while employed by it went to South America, Cuba and Mexico. The introduction of electricity for street railway purposes found Mr. Raub in the front rank, and he has proved himself to be one of the most valued men in the Sprague Company's employ. Mr. Raub has directed the electrical construction of street railways in all parts of America, and in cases of emergency and where quick work had to be accomplished, he has often been selected. Mr. Raub is naturally of a modest and retiring disposition, but he has a host of friends all over the country.

The West End Railway has recently put into service on its electric line between Dorchester and the Tremont House half a dozen open cars of novel design, elegant finish and increased seating capacity. The cars are a little over 30 feet in length, have ten seats instead of eight, as in the ordinary open car, will seat 50 people, and allow standing room for nearly as many more. They are mounted on two four-wheeled trucks after the manner of a steam railroad car, which results in very easy riding. All the rocking motion incidental to the four-wheel cars is removed, and the cars run smoothly even over the old-fashioned flat rail and over switches and frogs at crossings. Each truck is equipped with a 15 h. p. motor, so that both speed and power are equal to that of the ordinary car. In these cars an important advantage is gained in the matter of fenders. The wheels of each truck are so close together that the truck itself has very little tilting motion, and fenders can therefore be projected further forward than from the ordinary four-wheeled truck with a large wheel base. The trucks are also very near the ends of the car, so that a curved fender projecting nearly to the extreme end of the car can be carried. The effect of this fender running close to the track would seem to be to push anything on the track to one side rather than to drag it along. The trucks are the design, in their special adaptability to street railway work, of Master Mechanic Lewis Pfingst, of the West End Company, and furnish just the support needed for the long car body. The cars, as a whole, show the rapid strides that are being made in improving electrical street railway service, and, with their increased passenger accommodations, furnish another step toward the solution of the rapid transit problem. Several more of the cars are now being equipped in the Albany street shops, and will soon be ready for service. Part of them will be placed on the Eggleston square line.

L. H. H.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY BUILDING, PHILADELPHIA, AUG. 9, 1890.

The Electro-Dynamic Company, of this city, shipped last week two full carloads of electrical apparatus weighing 49,000 pounds to the far West.

Electric Fans.—The demand for electric fans has been so great during the warm season that the Electro Dynamic Company has found it difficult to fill its orders, and has been obliged to run overtime.

Pottsville, Pa.—The Schuylkill Electric Railway Company has closed a contract with the United Electric Equipment Company, of Philadelphia, for the construction and equipment of its road, to be commenced Oct. 1. The road starts with three cars and two generators, and will adopt the Wenstrom overhead system.

Warren Webster & Co., of Philadelphia, have found that their customers appreciate the value of the handsome trade catalogue which they have issued and which was noticed in our last issue. The firm name, however, was erroneously given as William Webster & Co. The correct form is that at the head of this paragraph.

Dover, N. J.—The Dover Electric Light Company has ordered one 1,000-light alternating dynamo from the National Electric Light Company to increase its plant. Acker & Bentz, well-known New York contractors, have the contract for all the construction work. They began work on Monday, the 5th inst., with a large force of men, and expect to have everything in operation in six weeks.

Bristol, Pa.—The Bristol Electric Light Company has concluded to enlarge its plant by the addition of a 100 h. p. steel boiler, for which it has placed its order with M. R. Muckle, Jr., & Co., of Philadelphia. The conservative and successful management of this company is a pattern for small stations. The managers have nearly the full capacity of their station called for every night, and are daily picking up a few lights here and there. Their next addition will probably be in the form of a compound Westinghouse engine in place of the Standard, which they now use.

Mr. G. A. Wilbur, the Philadelphia agent for the Fort Wayne Electric Company, has closed a contract with the Columbia Electric Light Company for the exclusive use of the Slattery incandescent system in the territory covered by its franchise. The Columbia company will start with 2,000 lights, and expects to increase to 5,000 by the end of the present year. Work has been commenced on the new station, which will be located on Twentieth street below Jefferson, and it is expected to have it in operation early in September. All wires will be put underground under the supervision of the Electrical Bureau.

New Car Shops.—The J. G. Brill Company's new car shops are nearly completed, and will be classed among the finest in the country. The Brill Company is doing an extensive business in the manufacture of street cars for electric lines all over the country. It has just commenced the shipment of an order for 175 cars for the Lindell Street Railway Company, of St. Louis, Mo. Cars are under construction for the entire line of the Toledo Electric Railway Company, and some of them have already been shipped. The Brill Company is making a handsome palace finish car body for the Wenstrom Consolidated Dynamo and Motor Company, of Baltimore.

A New Electric Company.—Mr. J. F. McLaughlin is having his company reorganized and will be backed by railroad people to the extent of a million dollars. They already have contracts pending to the amount of over five millions of dollars which cannot be closed until the company is reorganized. Mr. McLaughlin's car was run for seven months on the line of the People's Passenger Railway Company, and from a practical standpoint it was highly successful and did not require the expenditure of a penny for repairs during the entire seven months. The highest number of miles run on one charge was 69 which was considered to be an enormous mileage taking into consideration that the battery only weighed 2,700 pounds. Taking everything into consideration the McLaughlin secondary system has proven very successful.

W. F. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, Aug. 9, 1890.

The Cicero Electric Street Railroad executed a trust deed last week to D. S. Wegg for $1,000,000 at 6 per cent.

The Brown Electric Company has been incorporated at Chicago to deal in patents and patented appliances; capital, $1,000,000; incorporators, F. H. Brown, I. L. Moore and others.

Dr. Arthur T. Woods, professor of mechanical and electrical engineering in the University of Illinois, at Champaign, has been visiting friends in Chicago and vicinity during the past week.

The Leavenworth Electric Light Company, of Leavenworth, Kan., is increasing the capacity of its plant by the addition of a 68 × 73 building and 300 h. p. engine, at an estimated cost of $25,000.

The Jenney Electric Motor Company, Indianapolis, Ind., has recently sold a two h. p. motor to run an exhaust fan and a 20 h. p. motor to run the other machinery in the establishment of the Indianapolis News Company.

Electrical Exhibits.—Manufacturers, wishing to exhibit desirable electrical specialties at the Corn Palace Sept. 25 to Oct. 5, can obtain space, and have them cared for free of charge by addressing the Sioux City Electrical Supply Company, Sioux City Iowa.

The Chicago & Lake Shore Electric Railway Company has been incorporated at Chicago to construct and operate an electric road for carrying passengers and freight from Chicago to Fort Sheridan; capital, $1,000,000; incorporators, C. H. Renny, George O. Fairbanks, F. L. Brooks.

A Valuable Pamphlet.—The Jenney Electric Motor Company, Indianapolis, Ind., is mailing to its friends an illustrated work on "Electric Motors and the Transmission of Power by Electricity," that should be in the hands of every user of motors and every superintendent of a central station.

Mr. W. H. Bryan, for two years past the secretary of the Heisler Electric Light Company, of St. Louis, has resigned that position and accepted the management of the Chicago house of the Yale & Towne Manufacturing Company. Mr. Bryan is a graduate of Washington University, and has been secretary of the Engineers' Club of St. Louis for five years.

Julius Andrae, Milwaukee, Wis., has secured the contract for wiring the new hotel at Oshkosh, Wis., for a 110 number annunciator, guest call and fire alarm and for the elevator work. Mr. Andrae has also installed a temporary 20-light arc plant in the Milwaukee Opera House to enable the men to work all night, and is also placing a 50-light Mather dynamo in the Pabst Brewing Company's booth at the Milwaukee Exposition, to secure special illumination.

Mr. Henry C. Eddy has opened a manufacturers' agency with offices at 170 La Salle street, Chicago, and is in the market to handle electrical specialties and to thoroughly canvass the trade for such articles as may be placed in his hands. Special attention will be paid to the sale of incandescent lamps, switches, cut outs, etc., and manufacturers of these articles will do well to correspond with Mr. Eddy, who has had a practical training with the Edison Sprague interests, and is thoroughly familiar with the business and with the requirements of central station superintendents.

Mr. L. R. Curtis, of the Mendota (Ill.) Electric Light Company, was in the city this week securing supplies for the extending of his circuits to furnish the light srecently ordered by the City Council. Mr. Curtis is a firm believer in the benefit to be derived from a practical electrical exhibit at the World's Columbian Exposition, and believes that the ordinary visitors will be more deeply impressed with what is shown in the electrical section than in all else. As usual in all matters of this character Mr. Curtis stands ready to assist in whatever way he can to render the electrical section a grand success.

Mr. H. O. Woodruff has resigned his position as general agent of the Hawkeye electric motor, and L. G. Nilson his position as superintendent and electrician of the Des Moines Edison Light Company, to accept similar positions with the newly formed Sioux City Electrical Supply Company, at Sioux City, Ia. Mr. Nilson is looked upon as one of the brightest electricians in the West, and Mr. Woodruff has the reputation of having made more personal motor sales during the past three years than any other individual in the Northwest. We expect to hear good results from the work of these young hustlers with their new company.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	67@ 68	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 25
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

The United States Electric Car Company is the title of an organization just licensed by the Illinois Secretary of State to do business, with the principal office in Chicago. John A. Qualey, M. S. Debolt and J. H. Donnelly are named as the commissioners, and the capital stock is placed at $3,000,000. This company is organized for the purpose of building and operating electric street railways, rolling stock therefor, and, in fact, making all the appliances requisite for the same. The cars are to be propelled by storage batteries, this company owning and controlling the patents and improvements for that system. A large tract of land has already been purchased for the erection of the manufactory, and within the next 90 days the managers claim that the new plant will be in condition to turn out from four to six cars daily, with capacity increasing as the work progresses. The principal stockholders are eastern capitalists.

Proposed Electric Railways.—That an electric railway will soon be completed within the borders of Chicago there is no doubt, and probably each division of the city will soon be favored in like manner with this means of rapid transit. Yet it must not be forgotton that Mr. Charles T. Yerkes has for years unsuccessfully endeavored to secure from the City Council permission to use an electric system on his short lines, but was refused on the ground that overhead wires would prove objectionable in so large a city. So a simple practical conduit system ought to find a ready market in Chicago, and probably in some of the other large cities also. The question is often asked, Why do the projectors of storage battery cars not experiment on the side lines of Chicago? Possibly on the score of cash outlay and attendant expenses. If so, it is doubtful if the agent acted wisely who refused an order for 100 fully

equipped cars subject only to the single condition that the experimental car satisfactorily perform its duty for thirty consecutive days. Again, where can be found a more inviting field for the electric motor than the various elevated railway lines now being constructed in Chicago?

The World's Columbian Exposition.—If there is a single member of the electrical fraternity who believes that his fellow members will not be enthused over the subject of a grand electrical display at the World's Fair far exceeding in magnitude and in its value to science anything yet attempted, he should glance over some of the splended letters of advice, suggestions and congratulations received by Mr. John P. Barrett, of Chicago, during the past two weeks and he could not fail to have his energies stimulated so that he also will strive to add his mite towards making successful that section on which the Board of Directors are said to look for financial returns greater than from any other department. These letters have come from all sections of the country; from the local managers, the electrical engineer and the big Eastern manufacturer, and have been most cordially received, carefully noted, indexed and filed for future reference and form a valuable fund of information. The voluntary, harmonious and concentrated support already given Mr. Barrett is not only gratifying to his friends, but indicates that though the work may be far greater in its entirety than we can form any conception of at the present time, yet that indomitable courage that has ever characterized the electrical fraternity, coupled with the generous support already freely tendered, insures the application of practical business methods that will certainly produce a grand success. F. DE L.

SOUTHERN NOTES.

NORFOLK, VA., Aug. 9, 1890.

Waco, Tex.—It is stated that the purchasers of the Waco Street Railway will adopt electricity as the motive power.

The Capital Railway Company, of Frankfort, Ky., has been incorporated by Messrs. Fayette Hewitt, P. McDonald, John W. Pruett, John Meagher, W. H. Posey and John F. Buckley, to build an electric railway.

Little Rock, Ark.—The Capital Street Railway Company has secured permission to adopt electricity as the motive power on its road, which is 15 miles long. The line will be extended about 15 miles further. H. G. Allis, of St. Louis, Mo.; George R. Brown, of Little Rock, and others, are principally interested. Work is to be commenced at once.

Southern Westinghouse Plants.—Mr. D. A. Tompkins, general district agent for the Westinghouse Electric and Manufacturing Company, Charlotte, N. C., reports the following late sales: Excelsior Manufacturing Company, Washington, Ga., 500 lights; Waycross Electric Company, Waycross, Ga., 750 lights; De Castro Sugar Refinery, Franklyn, La., 300 lights; Curro Oil Company, Curro, Tex., 50 lights; Central City Guano Company, Macon, Ga., 50 lights; Edgefield Gin and Mill Company, Edgefield, S. C., 50 lights; Spartanburgh Oil Company, Spartanburgh, S. C., 50 lights.

Electrical Progress at San Antonio, Tex.—San Antonio, the second city in Texas, has always been very much behind in electrical matters, but is picking up somewhat now, and has under way at present the equipment of portion of the tracks of the City Street Railway with ten cars of the Sprague overhead system, to be in operation Aug. 15, this year, while the West End Suburban line is being equipped by the Thomson-Houston Electric Company. Two other lines are in prospect, one of which was contracted for quite recently with the Thomson-Houston Company. This line is to run to the Fair grounds. The Edison Company has been and is installing isolated plants for the San Antonio Ice Company and Crystal Ice Company, and much other electrical work of various kinds is in prospect. San Antonio is improving rapidly, and much outside capital is being invested. Several electric street car lines will be built during this fall and the coming season. San Antonio is a city of 65,000 people, and has now but one electric light plant. The Gas Company and the Electric Light and Power Company were recently purchased by Mr. H. D. Kampmann, who will conduct them as a single organization, furnishing power for street railways in addition to the lighting business. The streets are lighted by 110 Brush arc lights furnished until recently by the Gas Company, now by Mr. Kampmann. The electric light company also furnished current for 1,300 Westinghouse incandescent lamps. A large supply house is in contemplation by Messrs. Berg Brothers and the Great Western Electric Supply Company. There is said to be an excellent opportunity for any electric company desiring to exploit business in a new field. This is offered by the third annual International Exposition to be held there from September 30 to October 11, to which all electrical companies are invited, space and power being furnished to exhibitors free. This exposition will be attended by the best class of Mexican bankers, merchants, etc., to whom electric lighting is entirely new, and thus the Mexican field will be opened up to those desiring to cultivate it. The Telephone Company has purchased 600 telephones in the city and the service has been very much improved, the entire overhead construction being rebuilt. Mr. Kampmann, of the Electric Light Company, is also rebuilding the electric light works, adding to the machinery, putting in Westinghouse compound engines of large capacity and endeavoring to increase the demand for electric lights. Y. N. B.

ENGLISH NOTES.

(*From our own correspondent.*)

LONDON, July 30, 1890.

The Transformer Case.—Gaulard & Gibbs have been very unfortunate throughout the whole of their connection with transformers. They first introduced them into this country in the spring of 1883, when they were exhibited at an electrical exhibition in London. They lit some of the stations on the undergound railway, the transformers being in series. Ferranti found that Gaulard & Gibbs were likely to give him trouble, and he applied to have their patent revoked. But the inventors applied to amend their patent to enable it to cover parallel working; the court of appeal held that the effect of the amendment was to alter the nature of the invention, and revoked the patent. The House of Lords has upheld this decision, and thus the original inventors of transformers, who unfortunately hit on the series system instead of the parallel, have lost everything.

London and Paris Telephone Cable.—It is probable that in a few days the Post Office will have this matter in hand, as it only waits for the formal sanction of the French government. The conditions calculated by Mr. Preece are merely that the resistance of the line in ohms, multiplied by the capacity in microfarads, must be somewhere between 5,000 and 10,000. A special cable and four copper land lines will be provided. Extensive experiments have been made by the Post Office experts, who are confident of success.

Tramways with Accumulators.—A very complete station has been erected at Birmingham as the terminus of an electric tramway system, which is far more complete than anything that has yet been done. The experiments made in the suburbs of London were sadly mismanaged, and no figures of cost of working ever appeared. I feel confident that it only needs a complete affair, such as they have at Birmingham, to prove that traction by batteries is feasible, but it will not do for gradients even with a change of gear for reduced speed.

News of the Week.

THE TELEGRAPH.

Election of Directors—The stockholders of the Pacific Postal Telegraph Company have re-elected the following directors for the ensuing year: John W. Mackay, William C. Van Horne, Sir George Stephen, Charles R. Hosmer, Richard V. Day, Albert B. Chandler, Hector de Castro and George S. Ward.

Splendid Cable Service.—The London *Times* has shown considerable enterprise by its magnificent telegraph service from Buenos Ayres. It is the only newspaper in London which has a correspondent in the capital of the Argentine Republic, and spent over $30,000 during the last week in July telegraphing daily the story of the revolution. Cabling is $1.75 a word, but the dispatches was said to have been very complete and graphic.

William H. Abel, for many years auditor of the Western Union Telegraph Company, died in this city on Friday, Aug. 8. He was auditor of the old American Telegraph Company up to the time of its absorption by the Western Union. In 1868 he was appointed auditor of the latter company, and was the first to hold that position as an independent office. In 1872 failing health compelled him to suspend his work, and in 1874 his chief assistant, Mr. J. B. Van Emery, was appointed his successor. Mr. Abel was 54 years of age and was a man of fine mind, and of a clear, discriminating judgment.

Gen. Thos. T. Eckert, of the Western Union Company, seems to be a great favorite with his employés, judging from the way in which they rallied to his assistance in restoring order and systematic service after the recent fire in the company's New York headquarters. His letter expressing his high appreciation of the loyalty of every employé in rendering every possible service at that time has called forth many expressions of kindly regard for the able leader of the Western Union forces. Mr. Humstone, the superintendent of the first district, took occasion, in the reply to General Superintendent Tinker's letter, which we printed last week, to speak of General Eckert as "the right man in the right place."

THE TELEPHONE.

Dividends.—The Erie Telegraph and Telephone Company and Union Telegraph and Telephone Company have each declared a quarterly dividend of one per cent., payable Aug. 18, 1890, to stockholders of record Aug. 8; books close Aug. 8 and open Aug. 18.

The Union Telegraph and Telephone Company, for the quarter ending June 30, 1890, shows: Gross earnings, $6,215; expenses, $5,106; surplus, $1,108; dividend No. 7, $1,000; surplus, $108; surplus to March 31, 1890, $1,149; total surplus, $1,258; number of subscribers, 508.

Annual Meeting.—At a meeting of the directors of the Tropical American Telephone Company on the 5th inst., it was voted to pay a dividend of one per cent., or 10 cents per share, on the 15th day of August to stockholders of record Aug. 1, and a further dividend of 10 cents per share on the 1st day of October to stock of record Sept. 15, and that in future the dividend days will be April 1 and Oct. 1. The general manager's report showed a gain of nearly 100 per cent. over the preceding year, and the treasurer's report showed $24,000 cash and $25,000 bills receivable in excess of debts. Mr. Harry Highly was elected secretary and treasurer.

Decision against a Telephone Company.—A decision was reached on Friday of last week in the action of the Hudson River Telephone Company against the Watervliet Turnpike and Railroad Company, at Albany, N. Y., which has created considerable interest. The action was for a permanent injunction to restrain the railway company from operating its cars by single trolley electrical system, and for the damage to its business. Referee Lawson holds that the telephone company has no case, and accordingly dismisses it. The railroad company has been restrained by temporary injunction from operating its cars pending the suit and will now bring action for damages.

Quarterly Reports.—Erie Telegraph and Telephone, for the quarter ending June 30, 1890, shows for the Cleveland Telephone Company, the Northwestern Telephone Exchange Company and Southwestern Telegraph and Telephone Company the following with comparisons:

	1890	1889	1888
Gross	$189,392	$177,088	$163,662
Expenses	*127,940	109,975	104,569
Net	....	67,113	59,093
New construction	....	8,686	9,869
Balance	61,443	58,416	49,223
*Dividends	48,000	48,000	....
Surplus	†13,443	10,416	....
Subscribers added	417	249	204
Total subscribers	12,662	11,564	10,747

*Includes dividends on Bell Company's stock.
†Includes $9,843 surplus of sub company, a portion of which belongs to Bell Company.

The development of telephony in this country, says the National Telephone Exchange *News Letter*, is now so steady that it does not attract attention. According to the statement of the American Bell Telephone Company for the month ending June 20, there are 466,334 telephones in use in the various exchanges and on private lines, as compared with 430,476 at the same period last year. This shows a gain for the year of 35,858 instruments, or about 3,000 per month. These figures do not represent, however, the whole growth of the telephone business, as there is going on at the same time a rapid development of what is known as the extra-territorial system and of the long-distance system. The extra-territorial system links together the places a few miles apart in the same territory; the long-distance system unites cities hundreds of miles distant from each other. There is now a large amount of telephonic work between Boston, New York, Baltimore, Washington, Philadelphia, Albany, Buffalo, New Haven and other cities, while Chicago is again the centre of another field of activity in long-distance service.

THE ELECTRIC LIGHT.

Dividend.—The Hartford (Conn.) Electric Light Company has declared a semi-annual dividend of three per cent.

Phillipsburg, Pa.—The Electric Light Company is putting in an additional incandescent electric light plant.

Dividend.—The Quincy Electric Light and Power Company, Quincy, Mass., has declared a dividend of five per cent.

The Lynn Gas and Electric Light Company is to build a new one-story brick building, 30×70, in which water gas is to be manufactured.

Erie, Pa.—The Keystone Electric Company has been reorganized, with the following officers: Secretary and treasurer, J. W. Leech; electrician, C. J. Sturgeon; directors, George Platt, C. J. Sturgeon.

The Steamship "Michigan," the latest addition to the Atlantic Transport Line, running between Baltimore, Philadelphia and London, is fitted with electric lights and with an electric search light of 50,000 c. p.

Alameda, Cal.—The city electrician and electric light engineer has been directed to prepare estimates on the cost of supplying 500 or 1,000 incadescent lights from the present plant, and also the cost of needed improvements.

Bryan, Tex.—The Westinghouse Electric and Manufacturing Company has obtained the contract for furnishing its alternating current apparatus to a company recently organized in Bryan, Tex. The plant will have a capacity of 500 lights.

Election of Officers.—At the annual meeting of the Peoples Electric Light Company, Easthampton, Mass., the following officers were elected: President, Chas. W. Smith; treasurer, H. G. Knight; directors, Thomas Sawyer and John Mayher.

City Buys an Electric Plant.—A deed has been placed on record at Alameda, Cal., wherein the Jenney Electric Light Company deeds to the city of Alameda its interest in certain real estate and also its interest in the electric light plant now maintained in Alameda, the consideration being $23,000.

Milwaukee, Wis.—Bids for lighting the city with electricity for three years were opened by the Board of Public Works last week. The bid of the Badger company was $112.50 a lamp per year and that of the Milwaukee Light and Power Company $113. The Board did not expect the bids to exceed $90.

Search Light on the Lakes.—The owner of the new steel steamer "Emily P. Weed," of Buffalo, N. Y., has closed a contract for an electric search light to be put on her pilot house. The Edison Company claims it will show a buoy a quarter of a mile off and penetrate a half mile into a fog. This is one of the first search lights ordered for lake steamers.

Waycross, Ga.—An alternating current central station plant for incandescent electric lighting, is about to be established in Waycross, Ga. The company organized there has just awarded the contract for the apparatus to the Westinghouse Electric and Manufacturing Company. The plant will have a capacity of 750 lights, and the installation will be at once commenced.

Lighting Plant on a Lake Steamer.—One of the modern features of the equipment of the steel steamer "Maryland" is the 400-light incandescent electric light plant, furnished by the Fisher Electrical Company, of Detroit, Mich., including engine and one of its new automatic search lights. The entire boat will be wired with Grimshaw white core wire, and she will have one of the largest electric light plants on the lakes.

A Convention Souvenir.—A tastful and elegantly printed souvenir of the twelfth convention of the National Electric Light Association has been issued from the office of the secretary, Mr. Allen R. Foote. It contains a great variety of information as to the officers of the Association, the programme of the coming convention, the accommodations for guests at Cape May, the attractions of the place and the railroad facilities for reaching it.

An Edison Company in London.—The Edison Phonographic Toy and Automaton Company (limited) has been formed in London to acquire exclusive rights, free of royalty, for Great Britain, Ireland and continental Europe in Edison's phonographic patents as applied to toys, dolls, etc., also Jacques' improvements on the same, for £270,000, payable £100,000 cash and the balance in cash or shares, as the directors may determine. The capital stock is £300,000 in £1 shares.

Helena, Mont., as the capital of that youthful state of the Union, is showing all other cities and towns a good example by improving her illumination. A number of its enterprising citizens, who have established an electric light company, are now erecting a plant both for arc and incandescent lighting with a capacity of 1,500 incandescent and 40 arc lights. The plant will be furnished with the alternating current system of the Westinghouse Electric and Manufacturing Company.

The Electric Light Committee, appointed by the town of Peabody last March, reported at a special town meeting called Thursday evening that it would recommend the adoption of the Sperry arc light system, and the location of a town plant at the corner of Foster and Church streets, with a capacity of not less than 150 lights of 1,200 c. p. each. The committee also recommend that the town sell for commercial purposes any surplus light and power it may have. An appropriation of $30,000 is asked for to build and equip the plant.

Seattle, Wash.—The contract for the building of the East Seattle Electric Light and Power Company's station on Mercer Island, designed by architects Buelah & Alexander has been let for $3,500 and was to be completed by August 10. The station will be 40 × 60 ft. in size, with a tower 10 ft. square and 50 ft high. The Thomson-Houston systems of arc and incandescent lighting will be used, and the Edison generator for the motor line of railway. The circuits will be run from the tower of the building. The machinery and building will cost when completed about $12,000.

The collection of statistics for the electrical section of the census is going forward as rapidly as a thoroughly systematic treatment of the subject will allow. The census schedule blanks for central lighting and power stations have been prepared by Mr. A. R. Foote, the special agent in charge of this work, and are now being sent out to central station companies. This schedule is printed in sections, and made up in such a way that each company will receive only that portion that pertains to its particular line of central station work which it is doing. It is very desirable that each company should promptly attend to the filling out of these schedules as soon as possible. Co-operation in this matter will greatly assist in the collection and arrangement of valuable data that cannot otherwise be obtained.

Electric Lights in Bermuda.—A recent writer to one of the New York dailies says on this subject: "The next step will undoubtedly be electric lighting. There are no electric lights on the islands, and Bermuda is the place of all places where they would shine gloriously. There is a demand for them now, and the demand will soon be supplied. The corporation of Hamilton is enterprising enough to light the streets and the park with them, and that would make a new place of Hamilton; Mr. Aiken would be only too glad to put them in the Hamilton Hotel and light his grounds with them; the Princess Hotel would follow suit; the Governor's house, of course, would have to have them, and let them once shine at Government House and the receiver General and the Solicitor General and the Register General, and the Advocate General, and the Colonial Secretary, and the Chief Justice and all the other stars of the little Court, would rather die in their tracks than be without

them; the military and naval establishments would have them, and the principal business houses would use them. There is an excellent opening for an electric light plant in Bermuda; and if any of our American companies care to take the hint, I will not charge them anything for the suggestion. Some of those pretty water-side places in Bermuda would be beautiful almost beyond belief lighted up on the warm winter evenings with electric lights. It is hardly too much to imagine that some time the principal roads and the water front around Hamilton may glare with electric lights, and then people will wisely go to Bermuda to see the spectacle. I do not expect to see them come into general use in St. George's; the evolution there will be from candles to kerosene lamps."

Electric Lighting at Uniontown, Pa.—The Electric Light and Power Company, of Uniontown, Pa, has its plant in complete running order, the last of the contractors having left a few days since. The dynamos consist of one 500-light Westinghouse alternating machine, separately excited, and one 750-light Westinghouse self-exciting alternating machine. Wiring has been done for about 1,500 lights and there is talk of placing an additional machine at an early date. From 150 to 500 lights are supplied through the day and from 1,000 to full load after nightfall. This company some two months since secured the street lighting contract for three years. This calls for 40 new pattern arc lamps of 2,000 c. p. each, at $60 each per year, each additional lamp to be put up at $50 per year. About 54 arcs are now burning from 8 P. M. until 5 A. M. The current for the arcs is furnished by a 60-light Westinghouse alternating self-exciter. The light is said to be very steady and the regulation seems to be all that could be desired. Uniontown, however, is to have competition in electric light. Mr. S. E. Ewing, a prominent attorney, has presented a petition to the council asking that body to grant to another company the privilege of putting up poles for a new electric light line, with wires, poles and lights in various streets, alleys and lanes of the town. In the ordinance proposed by Mr. Ewing it is provided that no poles shall be erected on the main streets of the town except where unavoidable. He proposes to place the poles in the rear of the business houses and residences, from which they can be as conveniently wired as from the front. This proposition will remove the main objection to the ordinance, that there are already too many poles on the main streets. Mr. Ewing's movement is a notice to the present electric light and power company that, should the franchise be granted, it is not to enjoy the exclusive patronage of the city. It has, however, a three-year street-lighting contract and nearly all the available patronage of the business houses. As Mr. Ewing proposes to furnish power as well as light, it would seem that he ought not to lack business from the start. If Mr. Ewing is granted the privilege asked, he will at once put in dynamos of the Wood pattern in the new building of the Uniontown Light and Heat Company's artificial gas plant. The estimated cost of the plant complete is $20,000.

APPLICATIONS OF POWER.

Quincy, Mass.—The Manet street railway has increased its capital stock to $50,000, and is about to erect its own power station and make other needed improvements.

Salem, Mass.—At a meeting of the Board of Aldermen, held last Wednesday evening, the Electric Street Railway Company was granted the right to erect poles and wires for the operation of its road.

Seattle, Wash.—The Metropolitan Electric Railway Company has elected officers as follows: President, Col. J. C. Haines; vice-president, George H. Heilbron; treasurer, Jacob Furth; secretary, Maurice McMicken.

New Quarters.—The Brush Electric Company has leased to the Short Electric Railway Company the building at the corner of Mason and Belden streets in Cleveland, O., for a term of five years at an annual rental of $600.

The Nantucket (Mass.) Street Railway Company has been incorporated with a capital of $30,000. George C. Scofield, Henry O. Reed, T. C. Macy, R. B. Hussey, H. S. Ayer, George C. Pratt and John Harps are the directors.

The Neversink Mountain Electric Railroad at Reading, Pa., recently opened for regular service, was said to be one of the most difficult pieces of electric railway construction ever undertaken by the Equitable Electric Construction Company.

Sydney, New South Wales.—The Thomson-Houston exhibition electric railway track will be completed during September next and the Sprague road a few months later. There will then be every reason to expect a rapid advance in the introduction of the electric railway in Australia.

Tacoma, Wash.—The contract for building the Tacoma & Steilacoom electric railway line has been let by T. O. Abbot to Contractors Geiger & Zabriskie, to be finished not later than Nov. 1 next. The material has been ordered, and it is expected that the work will be completed before the contract time expires.

Salem (Mass.) Street Railroad Sold.—Another street railway deal is reported in the sale of the Essex Street Railway, which is in process of construction between Salem and Peabody, and nearly ready to run, to the Lynn & Boston R. R. It is reported that the sale is virtually complete, and the Foster street extension of the Lynn & Boston in Peabody will give them virtually a through line.

Consolidation of Street Railways.—The Pittsburgh, Allegheny and Manchester Street Railway Company, which has for years been in the horse street car business, has just been consolidated with the Pittsburgh and Allegheney Traction Company which will use electric power. Tre president of the P. & A. Traction Company is Mr. Joshua Rhodes The lines acquired by the new company cover a large portion of the city of Allegheny and will doubtless prove profitable upon the adoption of the electric system

Electrical Mining Machinery.—The Thomson-Houston Motor Company has begun the erection of a large electrical plant for the Atchison, Topeka and Santa Fe Company at the Castle Gate mine, Utah. The generating plant will have a capacity of 750 h. p., and the first application will be as follows: A 35 h. p. motor will be connected with a Lidgerwood hoisting engine, and will be used to hoist empty mine cars, 16 in a trip, up a grade of from 5 per cent. to 20 per cent. into the mine. The loaded cars run out by gravity. A similar motor will be attached to the large ventilating fan, and the main haulage roads will be illuminated by incandescent lamps. There will also be 25 arc lights on the surface to furnish light on the tipple and for other outside work.

At Harrisburg, Pa., a charter was granted last week to the Braddock and McKeesport Electric Railway Company. The incorporators are R. R. Burk, Chas. Weidman, of Allegheny, Pa., James H. Canfield, Jacob P. Mill, of McKeesport; John Q. Everson and B. M. Everson, of Pittsburgh, and H. S. Preston, of Homewood. Mr. James H. Canfield is the President of the company. The proposed line is to run from Braddock via Turtle Creek to McKeesport, and will be seven or eight miles in length. It is the opinion of unprejudiced observers that there will be a fair chance for a paying investment in the scheme. It goes without saying that when the time comes for propelling street cars over the line, electricity will be summoned to service.

The Squirrel Hill Electric Railway Company has been placed in the hands of a receiver. This organization was formed to build a street railway line for the purpose of tapping Squirrel Hill, a large suburban district of Pittsburgh, Pa., which does not enjoy the convenience of rapid transit. The projectors of the road were nearly all Squirrel Hill property owners. The work consumed money a great deal faster than was looked for and finally subscriptions ceased to come in at the call. As laid out, the road was to run through the recently opened Schenley Park, but Chief Bigelow recently put a veto on that part of the scheme. It is now thought that the Pittsburgh Traction Company will obtain the Squirrel Hill company, in which case the work upon the line will be pushed to completion.

Street car franchises in large cities in some cases are obtained only at a considerable cost. A case in point is the experience of an Allegheny (Pa.) gentleman, a late representative in the State Legislature, who was the possessor of a franchise for what is known as the Cross-Town Street Railway in the City of Allegheny. This franchise conveys rights for street car lines on several important thoroughfares of the city. The Pleasant Valley people desired it and offered the owner $5,000, with the result that he promised to sell for that sum, believing it a very fair price. One day after his promise was made, the Pittsburgh, Allegheny and Manchester Company declared a willingness to pay the snug sum of $50,000 for the rights. But they were one day too late, and $5,000 secured the right. Now the purchasers put an appraised value of $200,000 on the franchise.

PERSONALS.

Mr. John E. Ridall now represents the Short Electric Railway Company, of Cleveland, O., at Pittsburgh, Pa.

Mr. G. C. Sims, of the Armington & Sims Company, well known to the electrical fraternity, has been elected a member of the World's Fair Commission to represent Rhode Island.

Mr. Edward Lafloe, of Worcester, Mass., formerly with the Boston Electric Company, has resigned his position to accept a similar one as electrician with Mr. C. H. Page, of the Electric Construction Company, 28 Pearl street, Worcester.

Mr. Samuel B. H. Vance, Vice-President of the Mitchell-Vance Company, 836 Broadway, this city, died at his summer residence on Long Island last Monday morning. Mr. Vance had been engaged in the gas and electric light fixture business in this city for 35 years, and his firm is the oldest established in the city. Mr. Chas. L. Mitchell, the president of the company, died only about six months ago.

Mr. W. J. Needles, secretary and manager of the Electric Light, Power and Street Railway Company, New Birmingham, Tex., died at that place the 29th of last month. At the time of his death Mr. Needles was but 23 years of age. His remains were taken to Philadelphia, Pa., his former home, accompanied by Miss C. J. Needles, of Philadelphia, May Kimball, of New Birmingham, Tex., and Capt. M. D. Mather, of Austin, Tex.

Mr. Frank M. Gilley, instructor in physical and chemical science in the Chelsea (Mass.) High School, was in New York last week on a business and pleasure trip, and spent four days in this city and Brooklyn. Mr. Gilley's thorough knowledge of electrical matters in and about Boston made him a welcome caller at the offices of many New York men who are interested in the electrical progress in that section of the country.

Mr. Bernard Donehoo, night foreman of the Pittsburgh Traction Company, at Pittsburgh, Pa., was a surprised and pleased man one night last week. He was summoned by telephone to the power house, the message conveying the idea that something was wrong. Everything seemed to be working properly upon examination, and just as Mr. Donehoo was looking about a large crowd of employés appeared upon the scene and presented to Mr. Donehoo a handsome gold watch. Mr. Donehoo is just about to depart for a visit to his old home in Ireland.

Industrial and Trade Notes.

Mr. E. L. Edes, Plymouth, Mass., reports very large sales of his improved zincs.

The Mica Manufacturing Company, of 89 Fulton street, this city, is making to order from designs furnished them, a great variety of mica goods. Some very fine specimens have recently been made for export.

Giles Bro. & Co., Chicago, have called our attention to a very neat and appropriate design of pin, intended to be worn by the members of the National Electric Light Association, which they are now offering for that purpose.

The Atlantic Covering Company, Plymouth, Mass., is rapidly getting under way. Its new factory is completed, and is now being furnished with the latest improved machinery for the manufacture of magnet wire. Thomson-Houston motors will furnish the factory with power, the current being taken from the local electric light station, about a quarter of a mile away.

The Southern Electrical Manufacturing and Supply Company, Limited, of New Orleans, La., which has done quite a profitable business since April, 1889, has found its business growing so rapidly, that it is compelled to seek more commodious quarters. A handsome store and offices will be fitted up at 110-114 Baronne street, which the company will occupy after the first of October.

The American Leather Link Belt Company has recently made an improvement in constructing a new bolt machine by which they are able to make any size bolt required for the link belts. The company has been to a great expense to obtain a wire bolt that is of an even temper throughout. With increased facilities the steadily growing demand can be cared for in good shape.

Chas. A. Schieren & Co. are meeting with excellent success with their patent perforated electric belt. It seems to give excellent results. Recently the superintendent of a prominent electric light plant purchased one of these perforated belts, and it gave him such excellent satisfaction that he obtained the consent of the patentee, Mr. C. A. Schieren, to perforate some other belts that had been running in his plant. He is said to have found that these belts would run with less tension, and less noise, than any unperforated belt.

The Great Western Electric Supply Company has lately been receiving immense quantities of batteries, bells, annunciators and electric gas-lighting apparatus, but owing to the excellent methods of handling and storing the goods no annoyance is caused. This company also reports heavy orders for its street hood and porcelain cut-outs, beside the steady call for Simplex wire Some slight improvements have been made on the Pattee lamp hour recorder, and orders are now filled with what is considered a neater form than that recently illustrated in our columns.

The Crosby Electric Company, of this city, desires to notify its friends and the trade generally that it has purchased the Eclipse Electric Company of New York city, with its business and stock on hand, together with the patents under which the Hussey Eclipse and the Duplex batteries are manufactured, and that, hereafter, the business and manufactures of the Eclipse company will be carried on under its management. It is prepared with a full line of everything necessary to the conduct of the business, and will guarantee strict attention and prompt delivery of all orders entrusted to it.

The National Conduit Manufacturing Company, Times Building, this city, is laying 35,000 feet of conduit in Buffalo, N. Y., 20,000 feet in Philadelphia and 20,000 feet in Minneapolis, Minn. These are all three-inch conduits for the Cobb Vulcanite Cable Company's system. This company has adopted this style of conduit after thorough examination. The Cobb Company's improved system of underground distribution has been adopted in the above named cities by the local electric light companies. The National Conduit Company has nearly completed the 100,000 feet of conduit which it is manufacturing for the Bell Telephone Company.

Mr. H. A. Howard, manager of the New England department of the "C. & C." Motor Company, reports an unusual rush in the motor business. He has already installed this season over 200 horse power in motors, not including 50 fan outfits in the last six weeks. Mr. Howard has fortunately secured the services of his brother, Mr. J. W. Howard, formerly with Walter T. Glover & Co., cable manufacturers at Manchester, England, who introduced the first graphophone in England; and together they are enabled to handle the large increase of business in a very satisfactory manner. The "C. & C." Company is making a specialty of introducing its motors for use in running church organs and is meeting with very gratifying success.

The Wainwright Manufacturing Company reports that it is selling more than double the number of heaters, condensers and expansion joints that it was one year ago, and its plant at Medford has been found inadequate to meet the demand. As larger facilities were an immediate necessity, arrangements have been made with the Taunton Locomotive Manufacturing Company, whereby that company will manufacture a part of the Wainwright apparatus The superior facilities thus secured, the Taunton Locomotive Company being one of the largest manufacturing establishments in New England, will make it possible to carry a large stock and to fill orders promptly.

The Eureka Tempered Copper Company, of North East, Pa., has received the following testimonial from Mr. H. H. Walter, general manager of the Card Electric Motor and Dynamo Company, in regard to its tempered copper for electrical purposes: "In answer to your inquiry of the 21st inst., will say we are very much pleased with the tempered copper we have bought of you for our commutator sections. The sections have all been true to size, and as far as we can learn, are outwearing anything we have before been able to get. Though the cost is considerably higher than the ordinary copper, we have about decided to use Eureka tempered copper on all the dynamos and motors of our manufacture."

Lemuel Wm. Serrell, M. E., of 115 Broadway, this city, is meeting with great success in selling the Milliken patent pole for electric railways. He says that he recently closed with Murray Verner, Esq., of the Verner-McKee syndicate, for poles for the entire city of Buffalo; that he has already received orders from the Rapid Transit Street Railway Company, Newark, N. J.; Troy & Lansingburgh Street Railway Company, Troy, N. Y.; Essex Passenger Railway Company, Newark, N. J.; Buffalo Street Railway Company, Buffalo, N.Y.; Pittsburgh & Birmingham Traction Company, Pittsburgh, Pa.; Passaic, Garfield & Clifton Street Railway Company, Passaic, N. J., and Jersey City & Bergen Street Railway Company, Jersey City, N. J.; and that he has taken orders for over 6,000 poles during the last three months.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Edison Pearl Street Station.—1. When was the New York Pearl street station of the Edison Company opened for public lighting? 2. What was the total weight of each steam dynamo of that plant? E. R. M.

1. Fire was built under the boilers for the first time June 29, 1882. The first steam dynamo was started July 5 following, and July 8 1,000 lamps arranged on the upper floor of the building were placed in circuit. The plant was started, and the district lighted up for the first time, at 3 P. M., Sept. 4, 1882. 2. The weight of each dynamo, with its engine complete, was 60,336 pounds.

Cornell University.—1. Does Cornell University confer the degree of "Electrical Engineer" upon its graduates in the electrical engineering course? 2. To whom should I apply for information regarding the instruction in electrical subjects at that institution? DYNAMO MAN.

1. The degree of "Mechanical Engineer" is given to all graduates of the mechanical and engineering schools of that institution. The diploma given to the electrical graduates contains the statement that the student has spent two years in the special study of electrical engineering. The other two years of the course are almost identical with those of the mechanical engineering course. 2. Apply to Prof. Edw. L. Nichols, Ithaca, N. Y.

Electric Railway Speeds.—I have somewhere read of a method of determining the speed of a railway car simply by counting the rail joints passed over in a given time, but cannot now recall it. Can you tell me where I can find a statement of such a method? C. D.

The method to which you refer is a very simple and convenient one, though perhaps not often used. If the rails are 30 feet long, as they usually are, the number of rail joints passed over in 20 seconds will be the speed in miles per hour. This assumes that the ends of the two rails do not break joints, otherwise the rule will not hold good. The best practice, however, now places the rail joints opposite, and the click can be easily distinguished as the wheels pass over even a good joint. It should be noticed that this method also determines the armature speed when the ratio of car wheel and armature speeds is known.

Business Notices.

The Battery Cut-Out sold by the Electric Supply Company of Syracuse, N. Y., 105 South Warren street, is cheap. Thoroughly tested, it is giving complete satisfaction. It automatically prevents the short-circuiting and damaging of gas lighting and other batteries. Send for circular.

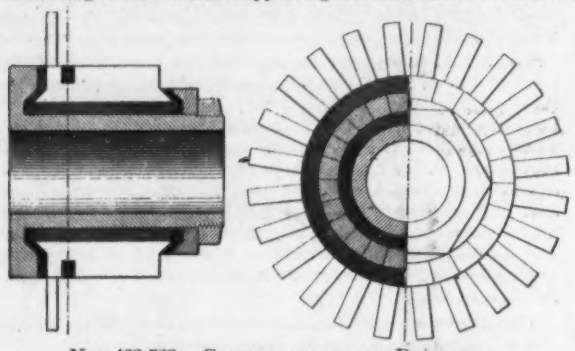
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. Patents granted Aug. 5, 1890.

433,445. Telephone Exchange Register; Joel C. Clark, of Morristown, N. J. Application filed May 25, 1889. The system of registering in telephone exchanges, comprising a rotary printing wheel provided with characters or marks indicative of the time elapsing between successive characters or marks, in combination with a time movement arranged to rotate the wheel once each ordinary division of time.

433,451. Thermo-Electric Element; Edward N. Dickerson, of New York, N. Y. Application filed Feb. 27, 1890. In a thermo-electric element, the combination of a comparatively fusible metal with a practically infusible cover surrounding one end of the same only, thereby avoiding the necessity of insulation between the cover and the element.

433,459. Lightning Rod Twister; Isaac M. Ferrell, of Stone Creek, Ohio. Application filed April 24, 1890. A tower, consisting of the vertical supporting rods connected at intervals



No. 433,523.—COMMUTATOR FOR DYNAMOS.

and at their upper ends by the rectangular connecting plates provided with openings for the passage of the rods and with a central aligning opening having a bushing formed of glass or other non-conducting material, and the lightning rod or conductor mounted in said bushings.

(1) 433,485, (2) 433,486. Municipal Signal Apparatus; Bernice J. Noyes, of Boston, Mass. Applications filed Sept. 23, 1889. (1) In a signaling apparatus, an electric circuit containing one or more signal transmitters adapted to change the condition of the current for intervals of long and short duration, (1) and a signal receiving instrument at the central station for receiving all the signals transmitted, combined with an electro-magnet, also at said central station, its armature and a retarding device for the armature, consisting of a pawl, ratchet wheel, escape wheel and pallet, and an audible signaling instrument, also at said central station, controlled by said armature.

433,504. Signal Apparatus; John C. Wilson and Bernice J. Noyes, of Boston, Mass., Assignors to the Municipal Signal Company, of Portland, Me. Application filed Sept. 9, 1887. This invention has for its object to provide a mechanical unison for the step-by-step devices, and also to provide a visual indicator of a different construction.

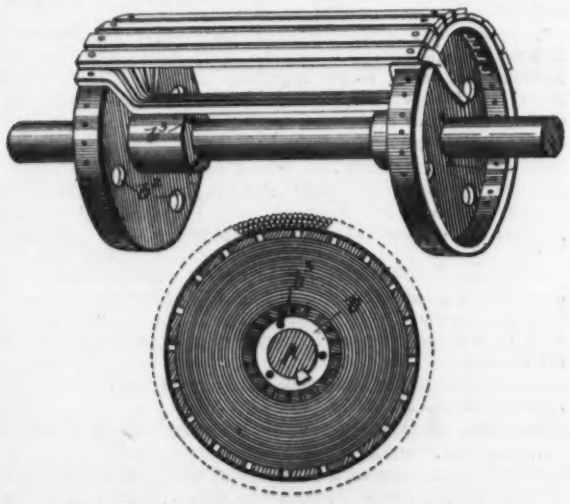
433,505. Light Signal System; John C. Wilson, of Boston, Mass., Assignor to the Municipal Signal Company, of Portland, Me. Application filed Nov. 24, 1888. The invention consists of a two-part colored glass globe or screen adapted to be raised to inclose a gas jet or other illuminating flame, and a motor mechanism is employed to raise the said two-part globe or screen, which is released by an electro-magnet.

433,523. Commutator for Dynamos; James W. Easton, of New York, N. Y., Assignor to P. Minturn Smith, of Plainfield, N. J., and William D. Perry, of Brooklyn, N. Y. Application filed Nov. 16, 1889. A commutator provided with a groove or channel to limit the width of its contact surface, such groove being filled with insulating material.

433,544. Electric Railway; Abraham A. Shobe and William Embley, of Jerseyville, Ill. Application filed April 7, 1890. In an electric railway a device for connecting the supply conductors with the motor on the car, comprising a hinge-plate, a link, a bifurcated bar, having slotted arms, axle boxes, adapted to slide vertically in the slots in the arms, spring insulating arms hinged to and depending from the axle boxes and adapted to carry the contact bars and connections between the latter and the motor, a guide or gauge wheel, journaled upon a non-revolving axle secured at each end in the axle boxes, said wheel adapted to travel upon a T-headed rail located between the two outer and main railway of the track.

433,557. Dynamo Electric Machine; Charles F. Winkler of Troy, New York. Application filed May 9, 1890. In an armature for dynamo electric machines, two discs or heads having inwardly projecting hubs, in combination with rigid coils of general rectangular shape, one side of the coils resting upon and supported by the hubs.

433,561. Cleat for Electric Wires; Lawrence Furlong, of Hartford, Conn., Assignor to Frederick C. Rockwell, of same place. Application filed February 18, 1889. The invention con-



No. 433,557.—DYNAMO ELECTRIC MACHINE.

sists of a flanged block adapted to be screwed to the ceiling and a second grooved block adapted to slide over the flanges the line socket being formed by the alignment of semi-circular grooves one in each block.

433,584. Electric Fire Alarm and Night Call; Charles J. Vining, of Cleveland, Ohio, assignor to Lewis C. Merrifield and Henry J. Farwell, both of same place. Application filed Dec. 2, 1889. In combination with a clock and an hour hand thereon, a perforated dial arranged in front thereof, an arm pivoted at the centre of the dial, a projection upon the arm with which the hand engages, pins removable fitted in the perforations of the dial for making contact with the arm, and an electric circuit including an alarm and having its terminals connected, respectively, with the pivoted arms and pins.

433,611. Trolley; Foree Bain, of Chicago, Ill. Application filed Feb. 7, 1890. In combination with a car having an electr motor for actuating it and a trolley device for a circuit, a double-jointed lever device, flexibly connecting the said trolley device with the car, and having an upright arm pivotally supported on the car to swing transversely thereof, and an arm pivotally connected with a second arm to extend at an angle therefrom, and swing on its pivot through a vertical plane.

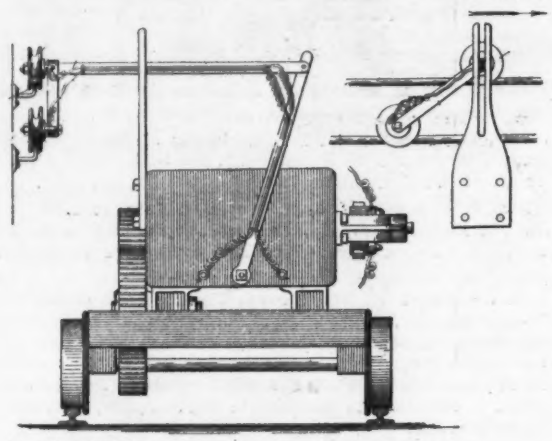
433,619. Electrical Communication; James L. Cutler, of Piketon, Assignor to Joseph A. Sullivan, Frank O. Loveland and Guy Mallon, of Cincinnati, O. Application filed March 8, 1889. The combination in an electric circuit, of an electro magnet, lever, pawl, permutation wheel, having projections and signal.

433,636. Multiple Switch Board; Ernest P. Warner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Jan. 31, 1887. In a multiple switch board system, the combination, with normally open switches or sockets of each of the lines, of a test circuit, and a branch from each test circuit to a switch or strip upon the loop switch of each, whereby the test circuit of any given line is closed to ground when the operator inserts a loop plug in the loop switch of the line.

433,637. Electrical Measuring Instrument; Edward Weston, of Newark, N. Y. Application filed Jan. 18, 1890. In an electrical measuring instrument, a stationary coil and a coil oscillating or vibrating on inclosed pivots in the field of force of the stationary coil, said coils being electrically connected.

433,671. Electric Soldering Iron; Charles E. Carpenter, of Minneapolis, Minn., Assignor to the Carpenter-Nevins Electro-Heating Company, of same place. Application filed May 10, 1890. In an electric soldering iron, the combination, with the hollow body and the tapering core fitting within the body, of the resistance disposed about the core, and electrical insulations interposed between the resistance and the core and body.

433,682. Fusible Cut-Out; William J. Jenks, of Nyack, N. Y. Application filed Feb. 17, 1890. The combination of a circuit, including an instrument to be protected, a circuit opening device wholly in the main circuit between the line and instrument, a branch or shunt between the circuit opening device and instrument containing electrically disconnected circuit terminals operative by a definite rise of potential before operation of the circuit opening device, whereby an abnormal increase of potential creates a low resistance path, causing an increased flow of



No. 433,611.—TROLLEY FOR ELECTRIC CARS.

current, thereby instantly operating the circuit opening device, and severing connection between the line and instrument.

433,687. Electrolier; Everett W. Little, of New York, and James T. Robb, of Mount Vernon, N. Y. Application filed Aug. 10, 1889. The invention consists in forming a ball and socket joint between the ceiling block and the stem of the electrolier, and concealing the said joint by a canopy surrounding the fixture stem, and provided with an aperture to permit of the movement of the fixture.

433,698. Incandescent Lamp Socket; Thomas G. Roebuck, of Jersey City, N. J., Assignor to the Insulite Manufacturing Company, of New York, N. Y. Application filed Oct. 3, 1889. A socket or holder for an incandescent lamp having secured directly thereto a swiveled coupling piece for attaching the same to the line wire carrier.

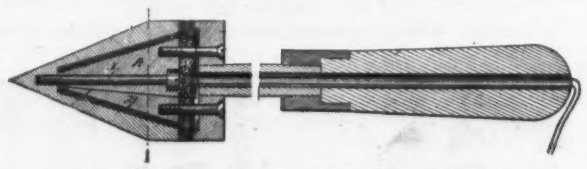
433,700. Alternating Current Electro-Magnetic Motor; Nikola Tesla, New York, N. Y., Assignor to Tesla Electric Company, of same place. Application filed Mar. 26, 1890. For description see page 101.

433,701. Alternating Current Motor; Nikola Tesla, New York, N. Y., Assignor to Tesla Electric Company, of same place. Application filed Mar. 26, 1890. For description see page 101.

433,702. Electrical Transformer or Induction Device; Nikola Tesla, New York, N. Y., Assignor to Tesla Electric Company, of same place. Application filed March 26, 1890. For description see page 101.

433,702. Electro-Magnetic Motor; Nikola Tesla, New York, N. Y., Assignor to Tesla Electric Company, of same place. Application filed April 4, 1890. For description see page 101.

433,706. Electric Circuit Coupling for Railway Trains; Watson P. Widdifield, of Uxbridge, Ontario, Canada, and Alexander Hamilton Bowman, of Allentown, Pa., Assignors by mesne



No. 433,671.—ELECTRIC SOLDERING IRON.

assignments to the Westinghouse Air Brake Company, of Pittsburgh, Pa. Application filed March 8, 1889. Renewed Feb. 4, 1890. Patented in Canada, Dec. 18, 1888 and in Italy, Dec. 18, 1888. An electric coupling consisting of the combination of electrical conducting casings provided with multiple interior electric terminals, electrically connected in pairs and insulated from the casings and spring electric terminals located upon the exterior of the casings and pressing upon the same, all the springs being included in electric circuits and the said casings being in electrical contact.

433,738. Galvanic Battery; Samuel William Maquay, of Fulham, County of Middlesex, England. Application filed Sept. 30, 1889. Patented in England Jan. 21, 1887; in France Aug. 12, 1887; in Germany April 16, 1887; in Austria-Hungary March 12, 1888, and in Belgium Oct. 15, 1888. The combination with a series of battery cells and the reservoir for supplying the batteries with liquid of taps controlling the flow of the liquid, an electric circuit including the batteries and an electro-magnet, and an armature and connections between the armature and taps, whereby when the circuit of the battery is closed the magnet will be energized, and the taps will be opened to permit the flow of liquid to the cells, and when the circuit of the battery is broken the magnet is re-energized, and the flow of liquid will be stopped.

433,744. Electric Current Controller; Milton O. Sargent, of Malden, Mass., Assignor of three-fourths to James N. George, of Plaistow, N. H., Charles A. Stearns, of Watertown, and Charles L. Bly, of Bradford, Mass. Application filed May 20, 1890. The combination of an electric current controlling device consisting of a coil of wire having a central metallic tubular core, partially filled with fluid, one end of which is secured to a support while the other end is free and curved, the said coil being normally in the main circuit, and a normally open grounded branch circuit adapted to be closed by means of said core.

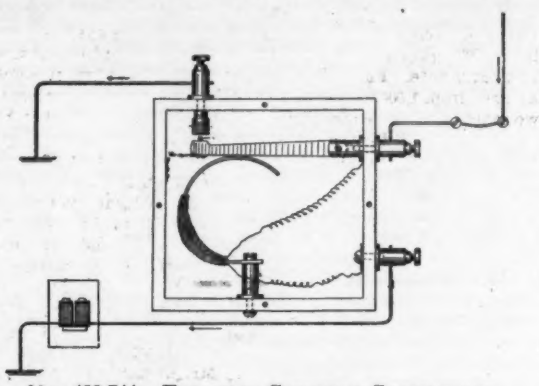
433,758. Current Converting Apparatus; Carl Zipernowsky and Maximilian Deri, of Buda-Pesth, Austria-Hungary; Application filed November 1, 1888. An apparatus for converting alternating electrical currents into continuous currents, or vice versa, consisting of a combination of a subdivided core having two or more coils conveying altornating currents with relatively shifted phases with another coil or coils, a commutator for the latter, and an iron armature carrying two or more brushes working on the commutator to convert the alternating currents into a continuous current, or vice versa.

433,770. Fuse and Fuse Block; Joseph G. S. Cunnington, of Covert Garden, County of Middlesex, England. Application filed March 21, 1890. Patented in England April 12, 1888. The object of this invention is to provide a fusible device which is very efficient, and is readily removed and put in place by unskilled persons, and by which the use of such a device unfitted for the particular circuit with which it is to be used and which it is to protect is prevented.

433,834. Induction Motor; Charles J. VanDepoele, Lynn, Mass. Application filed Apr. 23, 1889. For description see page 98.

433,835. Telegraph Key; John Barner Van Deusen, of Saratoga, N. Y. Application filed May 7, 1890. The invention consists in the combination, with the anvil contact and key lever, of a contact spring arranged to automatically close the circuit on the key lever and an auxiliary lever pivoted to the key lever for pressing the contact spring away from the key lever.

433,839. Trolley for Electric Street Cars; Franklin C. Wheeler, of St. Joseph, Miss., assignor of one-half to Henry Cor-



No. 433,744.—ELECTRIC CURRENT CONTROLLER.

bett, of same place. Application filed April 18, 1890. In an electric railway, the combination, with a pivoted, inclined spring supported arm having a trolley at its upper end, of a rock shaft under said arm, provided with an upwardly inclined arm engaging said trolley arm and means for operating the rock shaft.

433,851. Device for Unloading, Recharging and Reloading Electric Car Storage Batteries; Jacob C. Chamberlain, of New York, N. Y. Application filed April 24, 1890. In a device for unloading, recharging and reloading electric car batteries, the combination, with the battery racks, of the battery hoist and the workman's platform connected to and operated by the battery hoist.

433,883. Switch; Sigmund Bergmann, of New York, N. Y. Application filed Feb. 28, 1885. For description see page 102.

433,896. Support for Electric Wire; Albert L. Hallbauer, and Edward L. Hiller, of Lynn, Mass. Application filed Nov. 3, 1889. The invention consists of a trolly wire support or hanger, composed of two pieces or jaws having lugs to extend under and embrace the trolley wire, and lugs to prevent the said wire from lifting upward, and means to fasten the said jaws together to hold the wires between them.

433,903. Electric Motor Mechanism; Samuel E. Mower, of New Haven, Conn., Assignor to Henry G. Thompson & Sons, of same place. Application filed Nov. 9, 1889. The invention consists in an electric motor mechanism, of a combination with a shaft or axle provided with wheels, of a motor having its armature mounted to run loosely on the said shaft or axle, and a speed-reducing mechanism connected to the said armature and to the shaft or axle independent of the said wheels.

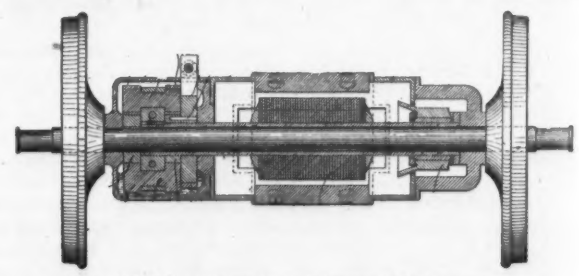
433,904. Electric Motor Mechanism; Samuel E. Mower and George J. Spencer, of New Haven, Conn. Application filed Feb. 14, 1890. The invention consists in the combination, with an axle, of a motor having its armature secured to a sleeve loosely mounted on the axle a speed-reducing mechanism consisting of a gear fast on the axle, a gear loose on the sleeve, a yoke or arm fast on the sleeve and carrying pinions in mesh with the gears, and a friction clutch mechanism adapted to hold the gear on the sleeve stationary to produce revolution of the car axle.

433,908. Electric Arc Lamp; Samuel P. Parmly, of Chicago, Ill. Application filed May 6, 1890. A multiple carbon lamp, one of whose electrodes is composed of a single strip or sheet, and the other of two or more distinct carbon pencils having a greater or less resistance between them.

433,915. Ceiling Block for Incandescent Electric Lamps; Alfred T. Tregurtha, of Everett, Assignor of one-half to Henry A. Clark, of Boston, Mass. Application filed Sept. 28, 1889. The combination, with a base provided with electric wire binding or contact blocks, each having a headed or shouldered pin or projection, of a cap or cover provided with spring hooks projecting laterally in opposite directions and arranged to engage with the pins or projections.

433,917. Method of Manufacturing Electric Conductors; Ernest P. Warner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Feb. 2, 1889. The method of manufacturing double stranded electric cords, which consists in making the different insulated strands semi-cylindrical, placing the plane surfaces of the two strands together and binding them together.

433,918. Electric Railway Conduit System; Malone Wheless, of Nashville, Tenn., Assignor, by Direct and Mesne Assignments to the Wheless Electric Railway Company, of Alexandria, Va. Application filed Oct. 5, 1889. The combination of two lines of conductors consisting of sections insulated from one another, electro magnets connected to one line of conductors



No. 433,904.—ELECTRIC MOTOR MECHANISM.

on opposite sides of each point of insulation, the armature of said magnets normally open and connected to the alternate sections of the other line of conductors, the other alternate sections of which are grounded, and a main circuit having an uncovered portion adjacent to the armature of the magnets, with a car having a motor circuit and a circuit provided with a source of electricity.

433,920. Joint for Electric Conductors; George L. Wiley, of Arlington, N. J., and Edward G. Acheson, of Pittsburgh, Pa., Assignors to the Standard Underground Cable Co., of Pittsburgh, Pa. Application filed March 27, 1890. A joint for electric cables in which the conductors are united and surrounded with insulating material and covered with a protective metallic coating, and spaces at each side of said coating are filled with insulating material.

433,921. Joint for Electrical Conductors; George L. Wiley, of Arlington, N. J., and Edward G. Acheson, of Pittsburgh, Pa., Assignors to the Standard Underground Cable Company, of Pittsburgh, Pa. Application filed March 27, 1890. A joint for cables in which the naked conductors are united, the insulated material and protective covering being removed for a certain distance each side of the joint, and the intervening space filled with strips of insulating material and the joint covered with an insulating sleeve.

433,922. Joint for Electric Conductors; George L. Wiley, of Arlington, N. J., and Edward G. Acheson, of Pittsburgh, Pa., Assignors to the Standard Underground Cable Company, of Pittsburgh, Pa. Application filed March 27, 1890. A joint for electrical conductors in which the insulated and protected conductor is exposed at its adjacent ends and the ends of the cable are joined by a sleeve of insulating material closely fitting the metallic coating at the adjacent ends of the cable.